Metal Show Section

The annual Metal Show starts at Philadelphia next week. In this issue, STEEL presents its Metal Show Section, beginning on Page 125. Highlight is STEEL's 1960 Metal Selector, the most up to date source of information on metals and alloys. For the show program, see Page 167.

STEEL

The

Metalworking Weekly

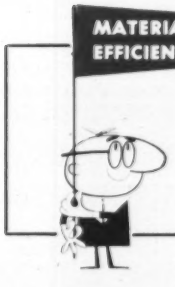
OCTOBER 10, 1960

A PENTON PUBLICATION

Equipment Ordering Edges Upward; Money to Buy More Is Available

How to Make Your Investment In Industrial Associations Pay Off

Expanded Uses of Thermoelectricity Spur Sales Boom for Tellurium



How to Hurdle Cost Barriers

No. 21 in STEEL's Program for Management

CONTENTS—TURN PAGE

IT PAYS YOU TO SPECIFY

B&W *Job-Matched tubing when ordering from your steel service center*

- B&W trains and assists Steel Service Center salesmen in job-matching tubes to customer applications
- B&W manufactures a wider range of steel tubing than any other source
- All B&W Tubing is produced to rigid quality control standards

For ease of fabrication, economy and service—be sure to specify B&W Job-Matched Tubing when ordering through your Steel Service Center. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

Steel

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TUBULAR PRODUCTS DIVISION

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Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

This Week in STEEL

The Metalworking Weekly

October 10, 1960 Vol. 147 No. 15

Equipment Sales Edge Upward

Cleveland economist James M. Dawson (photo) challenges the widespread belief that spending for plant and equipment is heading into a downturn. He points out that ample capacity by itself need not bring cutbacks in capital spending. The decline that some quarters predicted for this fall has not materialized. STEEL found, in a nationwide spotcheck, that a sizable downturn is not likely. In fact, some signs point to an upturn. If a setback does come in 1961, it's likely to be moderate. PAGE 81

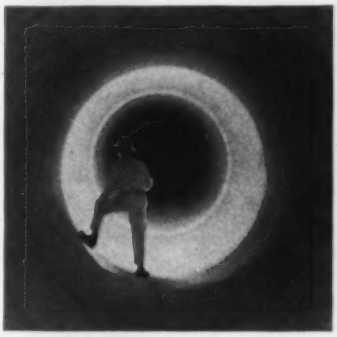
Association Membership Can Pay Off

Competition for your trade association membership dollar is becoming more intense. Today there are about 2000 national businessmen's associations. Just 20 years ago, there were only 1350. You should be getting a fair return on this investment of time and money. If you aren't, you'll find some helpful hints on PAGE 84

Materials Efficiency—How to Hurdle Cost Barriers

More standardization, better use of codes, and reform of restrictive laws can help you to gain greater efficiency in the use of materials. The U. S. economy could save at least $4 billion a year through standardization alone, believes the American Standards Association. PAGE 91

New System Is Pelletizing Iron Ore



Advantages of the traveling grate and rotary kiln are combined in the Allis-Chalmers Grate-Kiln system for agglomerating and pelletizing iron ore concentrate. The first commercial installation has gone into operation at the Humboldt Mining Co. plant near Ishpeming, Mich. Another installation has been ordered for Marquette Iron Mining Co.'s Republic, Mich., mine. Cleveland-Cliffs Iron Co. operates both facilities. The kiln (photo) is 10 ft in diameter and 120 ft long. PAGE 160

Thermoelectricity Spurs Sales Boom for Tellurium

If you plan to make, buy, sell or use thermoelectric devices, you'll be interested in what's happening to tellurium. Virtually ignored by metalworking until recently, tellurium has the highest capacity for heat and electrical generation of any metal known. Here's how the boom in thermoelectrics will affect tellurium, the supply-demand outlook, and price trends. PAGE 221

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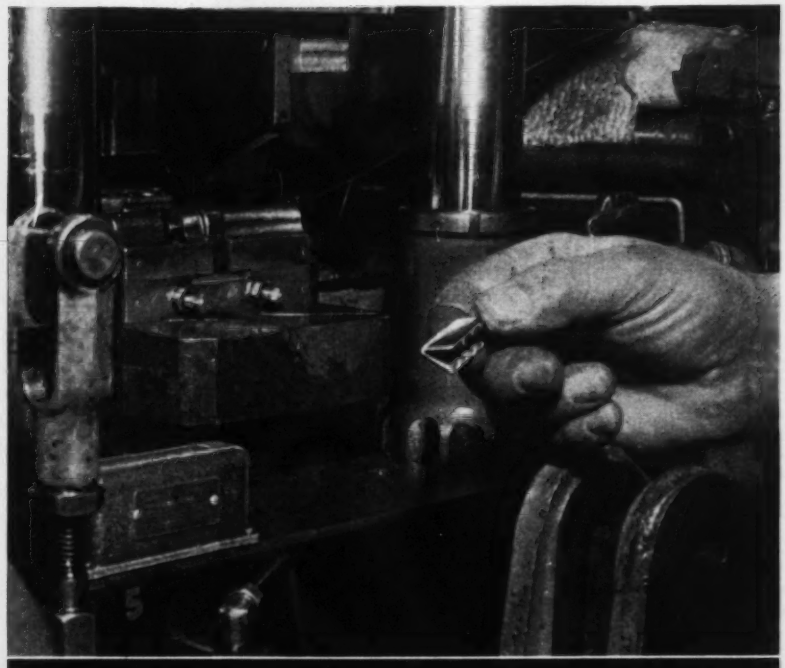
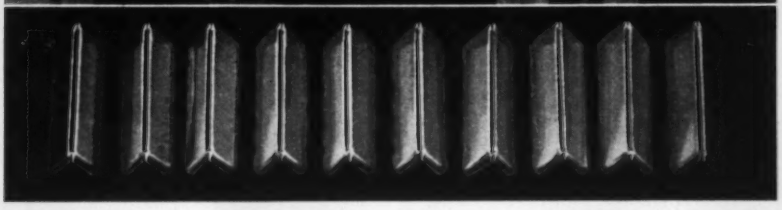
Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation





Lehigh H blanks and forms 1,000,000 pieces before redressing is necessary

Using a die of Bethlehem Lehigh H tool steel, Sobel Metal Products Co., Easton, Pa., produced this nickel-silver belt accessory, of the type used with army uniforms, at the rate of about 1,000,000 pieces before redressing was necessary. Blanking and forming .020-in. metal, the die was hardened to Rockwell C60-61. One of the requirements of the order was that no marking was permitted on the finished part.

Lehigh H (AISI D-2) is excellent tool steel for jobs like this. Not only is it the leader in machinability among the high-carbon, high-chromium tool steels sold today — it also has improved wear-resistance because its vanadium content has been increased to 1 pct.

As the result of a new manufacturing process, Lehigh H has improved carbide distribution and increased center density. It also has minimum distortion during heat-treatment.

If you want unexcelled machinability, excellent wear-resistance, and plenty of dependability, Lehigh H is your answer. See your Bethlehem tool steel distributor for prompt delivery.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Blind Holes Can Cause Plenty of Trouble

Unless one uses great care, blind holes can cause a lot of trouble when heat-treating tools. Holes for studs or dowel pins are typical of the blind holes which, as a rule, are paid little attention. Exposing blind holes to liquid quenching produces extremely high internal stresses, which can lead to cracking of the tool, either during heat-treatment or in service.

If it is not necessary for blind holes to be hard internally, these difficulties can be avoided by packing the holes prior to the quench, using clay, asbestos rope, steel wool, or a steel plug.

Blind holes are particularly objectionable if they must be uniformly hard on the inside surface. The only way to meet this requirement consistently is to select a grade of air-hardening tool steel.

Be Sure to Try Red Sabre Tool Bits

You're sure of economical cutting when you use Bethlehem Red Sabre Tool Bits, regardless of the type of application. Red Sabre is a super high-speed steel, with about 1.50 carbon, 12.00 tungsten, 5.00 vanadium, and 5.00 cobalt. The bits have high red-hardness and uniform hardness all the way through, for peak resistance to wear and maximum cutting ability. They come hardened to Rockwell C65.

Keep your automatic welding processes versatile! Select equipment that easily converts to new materials and processes. Gain the cost cutting advantage of always having the best process for every job. Let Hobart show you how you can beat obsolescence with the world's most advanced line of automatic welding equipment.

PLAN AHEAD with HOBART

Check into the cost saving features of this convertible welding head. It welds four ways automatically. With it you can take advantage of the newest metalworking materials and processes.

AIG

JUST CHANGE COMPONENTS to select the best process for the job

1. INERT GAS SHIELDED. Use this AIG (inert gas) welding head to speed your production on copper, aluminum, magnesium, steel, stainless, monel, and other alloy metals.

2. CARBON DIOXIDE (CO_2). Replace the basic unit's nozzle with a waterless side delivery Carbon Dioxide (CO_2) nozzle and increase your welding production on mild steel work.

3. SUBMERGED ARC WELDING. Add this flux hopper and do automatic submerged arc fabrication, buildup, and hardsurface welding.

4. USE TUBULAR and FABRICATED WIRE for open arc fabrication, buildup and hardsurfacing and for submerged arc or gas shielded welding.

Ask for Bulletin ST-100

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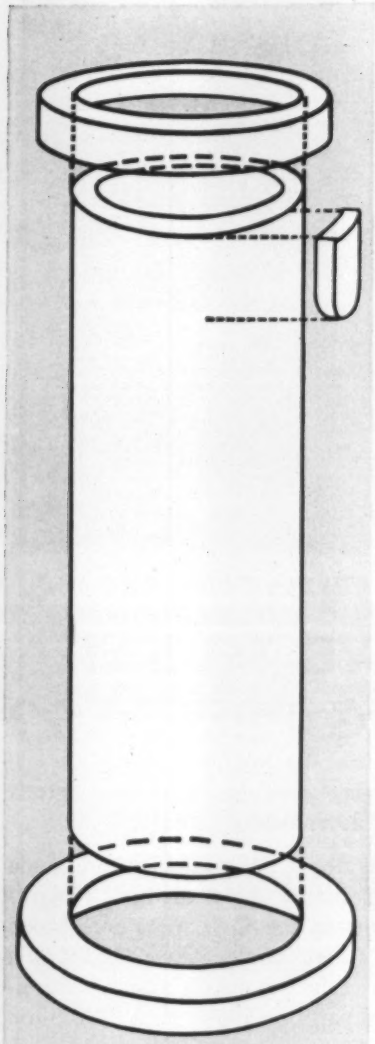
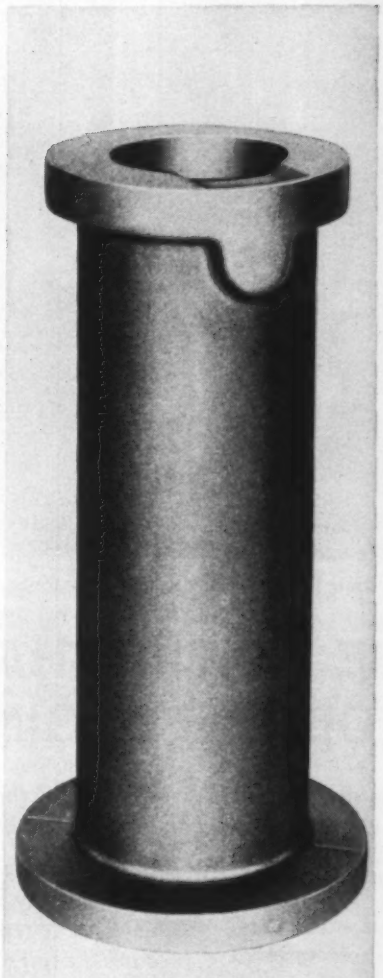
"Manufacturers of the World's Most Complete Line of Arc Welding Equipment"

Unusual 1-piece design replaces 4-part assembly



Schematic showing parts assembly of barrel blank weldment.



Externally upset tube includes unusual boss, eliminates three parts. Barrel blank from SAE 1020 seamless tubing 3½" O.D. x 13/32" wall. Finished length 10.062". Finished weight 13 lbs. 2 oz.

COMMERCIAL exceeds the commonly accepted technique and specializes in unusual upset forging... combining advanced engineering with practical ingenuity. Here's how!

BARREL BLANK—Originally, the part was a weldment made from a tube, two flanges and a boss. Now, the complete barrel blank is "Task-Forged" by externally upsetting only one piece of tubing in a patterned die designed and developed by COMMERCIAL. This resulted in closer tolerances and less distortion than the previous method.

In addition, as an upset forging the part now possesses added tensile and torsional strength resulting from controlled grain flow while the metal is being displaced. Even more... the part now has a more efficient metal distribution.

Material saving: 15%. Reduced machining time: 30%. Overall customer benefit: a better, stronger part at less cost!

COMMERCIAL quality control assures a scale free machining surface by Hydra-Jet descaling stock before forging. And, Magnaglo® inspection double checks the finished forgings for internal seams, grain structure defects. Let the experience of COMMERCIAL's 30 plus years of producing top quality, unusual upset forgings work for you—to beat down unit costs while beating in tougher metal quality. Send print or prototype for study and estimate—no obligation.

Address: Commercial Shearing & Stamping Company, Dept. L-42, Youngstown 1, Ohio.

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Specialists in the shape of things to come

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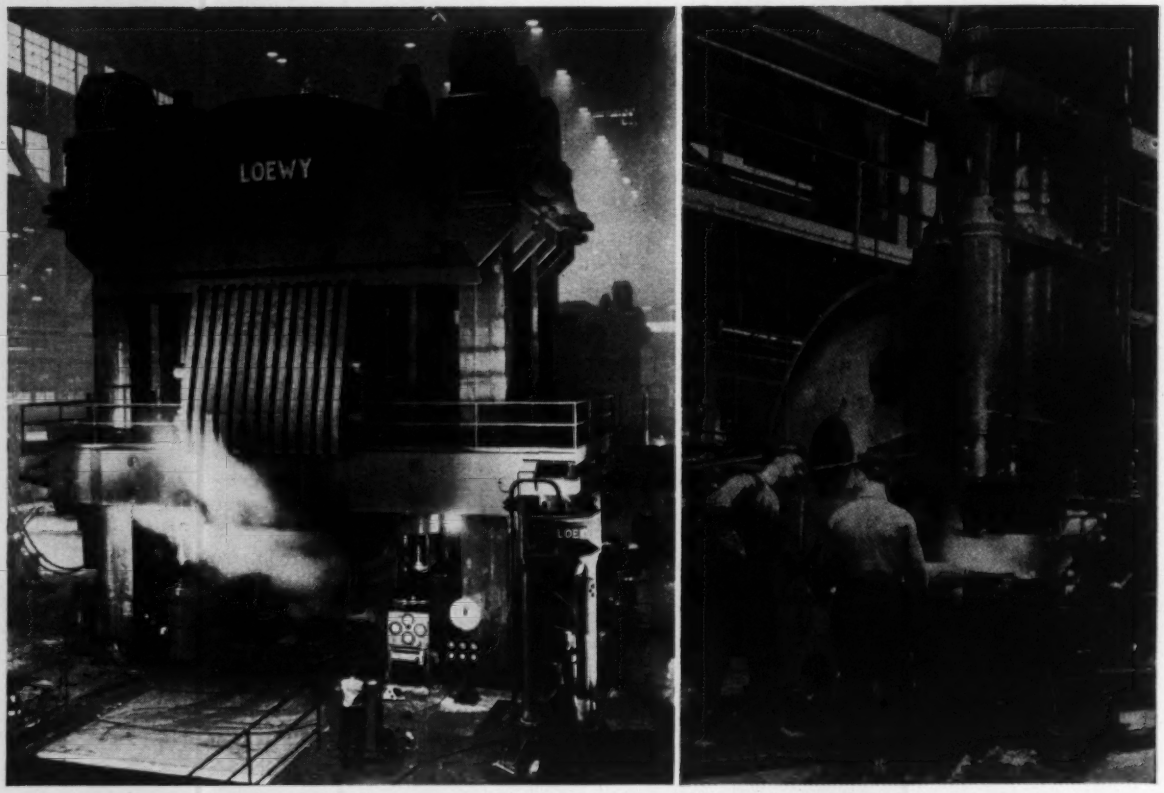

These two Loewy presses graphically illustrate B-L-H's ability to meet your forging press needs, regardless of press size.

WHAT DO THE CRITICS HAVE TO SAY ABOUT B-L-H LOEWY FORGING PRESSES?

We're talking about the severest, most discriminating critics we know—our customers. With a substantial capital investment involved, they unhesitatingly demand that Loewy presses perform superbly.

Here are just two examples of our customers' judgments. A leading alloy steel manufacturer in Pennsylvania spotlights our 2000-ton forging press in his full-page advertisement in national magazines.

The copy states that the Loewy press improves the production of his quality tool steels and that it is ". . . speeding delivery of more-uniform large forgings" in regular production and is ". . . ready to meet special custom forging demands."

Another well-known steelmaker stimulates his sales by means of two brochures which focus on his Loewy press. He testifies that "this fast-acting 2000-ton hydraulic forging press imparts to special steels internal qualities never before achieved."

Similar statements about our equipment are made very frequently. Certainly one of the most remarkable is in a report to the U.S. Air Force which foresees savings of approximately $13,000,000 on a single model of a jet fighter, thanks to the economical production of parts on the famous 50,000-ton Loewy forging press.

B-L-H builds presses for free forging, open die forging, and closed die forging, for hot and cold working of all kinds of metals—ferrous and nonferrous, rare, nuclear and exotic. These machines are available in all capacities from *five hundred to fifty thousand* tons or more. Write Dept. B-10 for further information.

BALDWIN · LIMA · HAMILTON

Industrial Equipment Division • Philadelphia 42, Pa.

BALDWIN BLH LIMA-HAMILTON

Views on an Issue

H. H. Whittingham, president and general manager, Long Mfg. Div. (Detroit), Borg-Warner Corp., writes: ". . . every member of Congress should receive a copy of your Sept. 5 issue, and it should be required reading . . . the government must . . . equalize tariffs on a reciprocal basis . . . The problem of allowable depreciation calls for prompt attention . . . as (do) changes in taxation . . .

"The only answer is to fight it out on a straight competitive basis, but industry must have some of the handcuffs removed and labor must wake up to the realities of the situation, which they definitely have not done yet."

An Eye for an Eye

"You are one of the few major trade publications striving to alert U. S. manufacturers and workers to the seriousness of foreign competition," notes E. J. Ward, vice president-marketing, Cameron Machine Co., Dover, N. J. ". . . Any rational businessman is opposed to economic isolationism. Every rational businessman sees the need for a protectionist tariff policy which will equate tariffs by dealing with each country respectively—product for product, cost for cost, tariff for tariff . . . Continue your aggressive and intelligent attack on solving this dilemma, but add to it your support for a fair protectionist argument."

A Second $500 Usership Award . . .

. . . was won by our March contest victor, Loren W. Smith, assistant vice president, metallurgical development, Symington - Gould Co., Depew, N. Y., a division of Symington Wayne Corp. He is the first of six monthly winners to earn the full $1000 Usership Idea of the Month Award. Here's a portion of the proof he submitted:

". . . STEEL's article in the Mar. 7 issue, regarding the Griffin Wheel Co.-U. S. Steel Corp. objective of pressure pouring steel billets, prompted my proposal that our company develop a technique using permanent metal molds and direct pouring . . . We have set up and operated a machine capable of opening and closing air cooled copper molds, suitably arranged for repeated pouring of molten steel and removal of the solidified but red hot billet . . .We are currently evaluating the influence of pouring and cooling variables on the properties of the billets . . ."

Mr. Smith also sent along seven photographs which illustrated the process and clinched his second award.

So far, STEEL readers are richer by $3500 as a result of reading and using ideas to be found on these pages. Remember, four weeks remain before the deadline in the September contest. Here's how . . .

You Can Win $1000 This Month

Just tell us, in 300 words or less, how you plan to USE an article or advertisement in this issue (or any other issue published this month, October, 1960) to help you accomplish an important personal or company objective. Be as specific as you can. If, in the opinion of the judges, yours is the best idea submitted—**you will win $500.**

There's more . . . You will win an additional $500 if you furnish written proof that you accomplished your objective. Proof must be submitted within six months after you are declared winner of STEEL's Usership Idea of the Month Award.

You may enter as many times as you wish. Please identify your letters as Usership entries. They will be judged by a committee of STEEL's editors. All letters become STEEL's property.

Send your entries to me, Ed Service, Servicenter, STEEL, 1213 W. Third St., Cleveland 13, Ohio. **Deadline for this month's contest is Dec. 1 (just in time for a Christmas bonus).**

Guides for Posterity

Last week, Washington Editor Jack Botzum delivered copies of STEEL's Guides for Steel and Stainless Steel Buyers, among other works, to Robert Curran, program executive for forgings, Iron & Steel Div., Business & Defense Services Administration. Seems the government is storing compendiums of business information at ten relocation centers in the U. S. (or someplace). In the event of a

HOW TO MEASURE MORTAR PERFORMANCE

One good way to judge the performance of a refractory mortar is to subject it to an extra-tough assignment. Apply this yardstick of measurement to Metalok and you will have the answer to the problem of joint erosion in ladle and fire brick linings. Metalok has proven in countless installations that it successfully resists heavily laden iron oxide slags for record highs in ladle lining life. Metalok will more than measure up to your expectations in steel mill applications.

Write us for details.

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FOR OVER 60 YEARS MANUFACTURERS OF HIGH GRADE REFRACTORIES

cataclysmic disaster, A, H, or other bombs, the people remaining on earth can begin to put civilization back together again—using information from the secret storage areas.

When the request for guides hit our offices, the editors went into a flap. (The guides have been out of print for a few years.) Some hollered: "I use mine everyday." Others furtively hid theirs at the bottom of desk drawers. Copies circulated faster than counterfeit Cuban pesos at a Miami race track.

Our Own Storage Area

Someone remembered that Associate Managing Editor Vance Bell, one of the prime authors of the guides, probably has more steelmaking data tucked away in odd corners than anyone else on the staff. We approached him and asked if he believed in education. (A loaded question—Vance is serving his fifteenth consecutive year on the Avon Lake (Ohio) Board of Education, is its president, and is also president of the Northeast Region of the Ohio School Boards Association.)

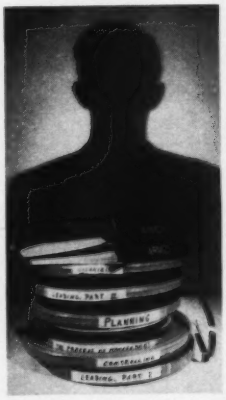
He admitted he believed in education.

We said: "Wouldn't it be a terrific job to re-educate the peoples of the world if most of civilization were destroyed?"

His reply: "We're having a tough time now—the problem would be immense."

From that point, getting the extra set of guides was easy. Well, at least the talk was easy. In the event of enemy attack, call Vance. He had the books about as safely hidden as the government could possibly do it.

Ubiquitous Training

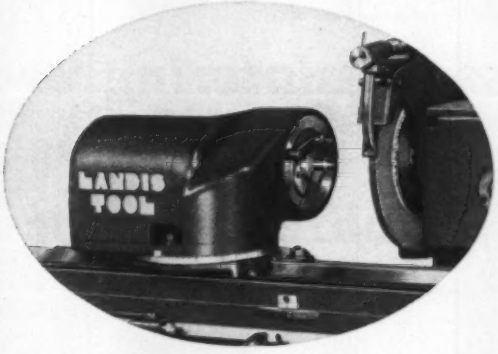


This stack of training aids forms the heart of a mobile management education program that can be everywhere at the same time. It is Armco Steel Corp.'s course, "The Profession of Management," which utilizes a new movie-conference method that each year reaches about 2500 managers internationally.

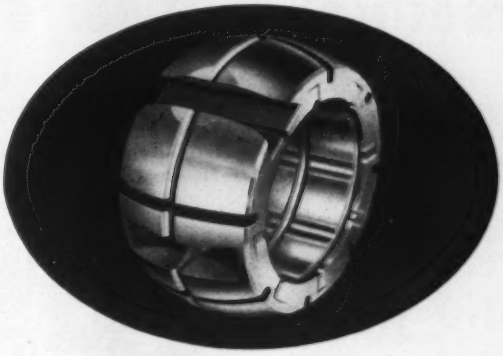
In the past, the Middletown (Ohio) company had tried intensive consultation sessions, sent managers to university and association development courses, and experimented with indoctrination of subordinates by top executives.

The need for something better has resulted in a well balanced training program which Assistant Editor Reed Trask will fill in for you in next week's issue.

Low cost general purpose grinder with 2 exclusive "big grinder" features...



Variable speed headstock... compact design with only two revolving parts. Can be swiveled for angle or face grinding.



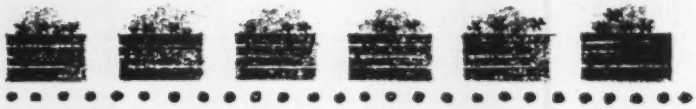
Microsphere bearings... close running clearance of Landis Microsphere spindle bearings gives faster spark-out, accurate, quick response to wheel feed.

LANDIS 12" x 28" Grindwell Universal ... compact, precision grinder for manufacturing, maintenance, toolroom and training.

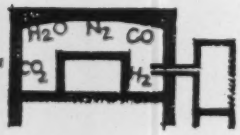
LANDIS
precision grinders
LANDIS TOOL COMPANY / WAYNESBORO, PENNA.

IF you want to HEAT metal . . . .

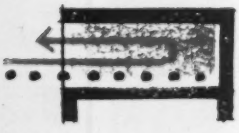
(melting, forging, brazing, sintering or treating) . . . . ferrous, nonferrous or exotic . . . . whether your parts travel one at a time **in batches**

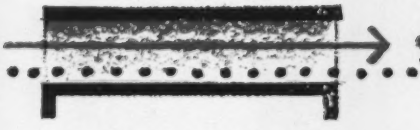
or in droves 

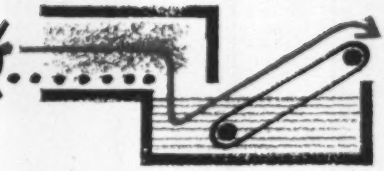
in a straight air atmosphere . . . . or in a protective atmosphere

or 

an upgrading atmosphere

in & out  **down & up**

straight through 



or in a combination

with manual operation

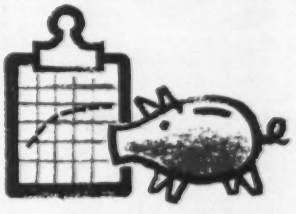
or automatic AND if you want

the economy of standard equipment

the least costly fuels . . .

PLUS known production rates and

pre-rated operating costs



WHAT DO YOU NEED? (pit, pot, box,

link, muffle, tube, snap or lab furnace)

. . . SURFACE MAKES IT!

See us at the Metal Show
Booth 1540

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In Canada: Surface Industrial Furnaces Ltd., Toronto, Ontario.

A division of Midland-Ross Corporation MR

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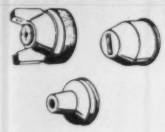
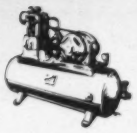
EVERYTHING
for spray painting and coating

PAINT SPRAY GUNS
of every kind



GUN NOZZLES
for all paints, coatings

SPECIAL SPRAY GUNS
for heavy materials



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SPRAY BOOTHS
over 510 styles and sizes

FLUID HANDLING PUMPS
6 models

EXHAUST FANS
meet safety standards

OIL & WATER EXTRACTORS
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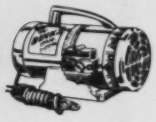

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Oct. 12-14, Gray Iron Founders' Society Inc.: Annual meeting, Netherland-Hilton Hotel, Cincinnati. Society's address: 930 National City-E. 6th Bldg., Cleveland 14, Ohio. Executive vice president: Donald H. Workman.

Oct. 13-15, Nonferrous Founders' Society: Annual meeting, Grove Park Inn, Asheville, N. C. Society's address: 1604 Chicago Ave., Evanston, Ill. Executive secretary: Herbert Scobie.

Oct. 16-18, National Metal Trades Association: Western Plant Management Conference, French Lick-Sheraton Hotel, French Lick, Ind. Association's address: 337 W. Madison St., Chicago 6, Ill. Secretary: Charles L. Blatchford.

Oct. 16-19, National Association of Sheet Metal Distributors: Annual convention and exhibit, Dennis Hotel and Convention Hall, Atlantic City, N. J. Association's address: 1900 Arch St., Philadelphia 3, Pa. Executive secretary: Thomas A. Fernley Jr.

Oct. 16-21, American Trucking Associations Inc.: Annual meeting, Waldorf-Astoria Hotel, New York. Association's address: 1424 16th St. N.W., Washington 6, D. C. General manager: R. G. Atherton.

Oct. 17-18, Magnesium Association: Annual convention, Carter Hotel, Cleveland. Association's address: 122 E. 42nd St., New York 17, N. Y. Executive secretary: Jerry Singleton.

Oct. 17-19, American Society of Lubrication Engineers and American Society of Mechanical Engineers: Joint lubrication conference, Statler-Hilton Hotel, Boston. ASLE's address: 5 N. Wabash Ave., Chicago 2, Ill. Executive secretary: Calvert L. Willey.

Oct. 17-21, Metallurgical Society of AIME: Annual fall meeting, Sheraton Hotel, Philadelphia. Society's address: 29 W. 39th St., New York 18, N. Y. Secretary: R. W. Shearman.

Oct. 17-21, National Management Association: Annual meeting, Dinkler-Plaza Hotel, Atlanta. Association's address: 333 W. First St., Dayton 2, Ohio. Executive vice president: Marion Kershner.

Oct. 17-21, National Metal Exposition & Congress: Trade and Convention Center, Philadelphia. Sponsor: American Society for Metals, Metals Park, Novelty, Ohio. Managing director: Allan Ray Putnam.

Oct. 17-21, Society for Nondestructive Testing: Annual meeting, Philadelphia. Society's address: 1109 Hinman Ave., Evanston, Ill. Secretary: Philip D. Johnson.

Oct. 19-23, National Tool & Die Manufacturers Association: Annual meeting, Leamington Hotel, Minneapolis. Association's address: 907 Public Square Bldg., Cleveland 13, Ohio. Executive vice president: George S. Eaton.

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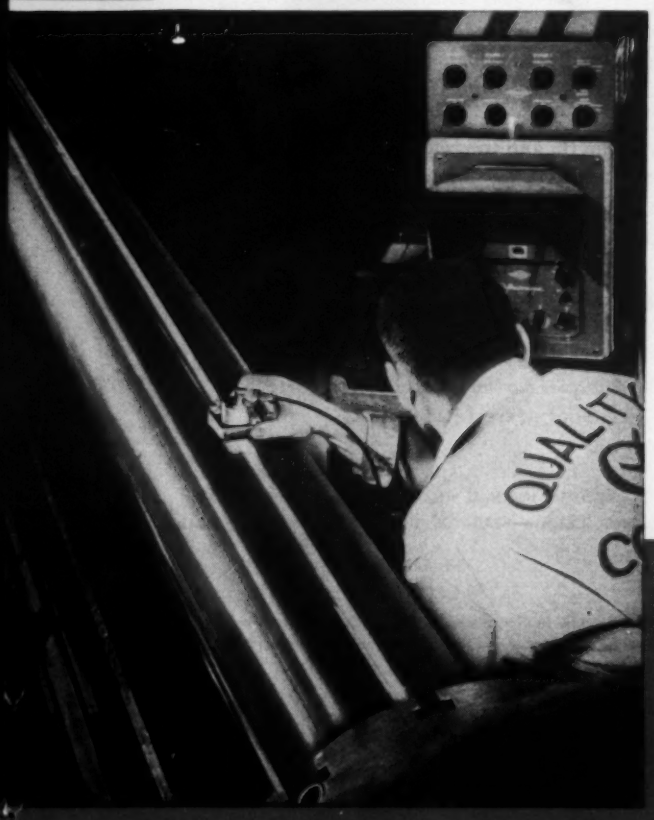

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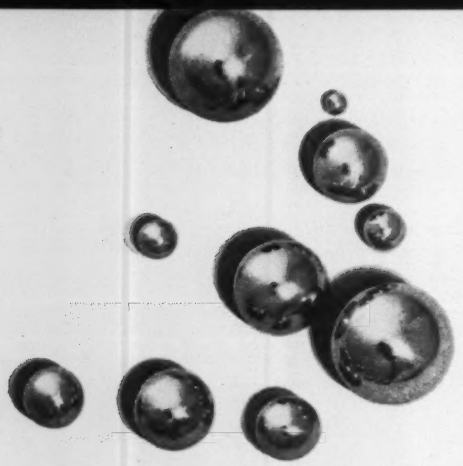

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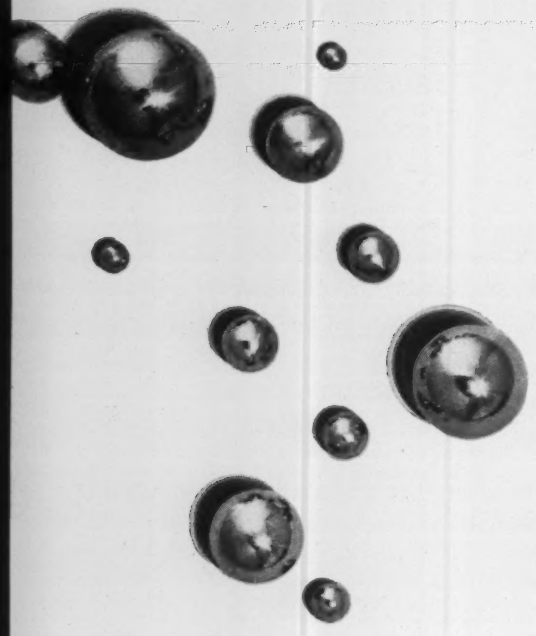

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Our metallurgists will quickly help you select, apply, and process vacuum-melted metals: *super alloy steels, constructional alloy steels, high strength alloy steels, bearing steels, stainless steels, titanium,* and *special carbon steels.* For complete information, contact your nearest Republic sales office or return the coupon.

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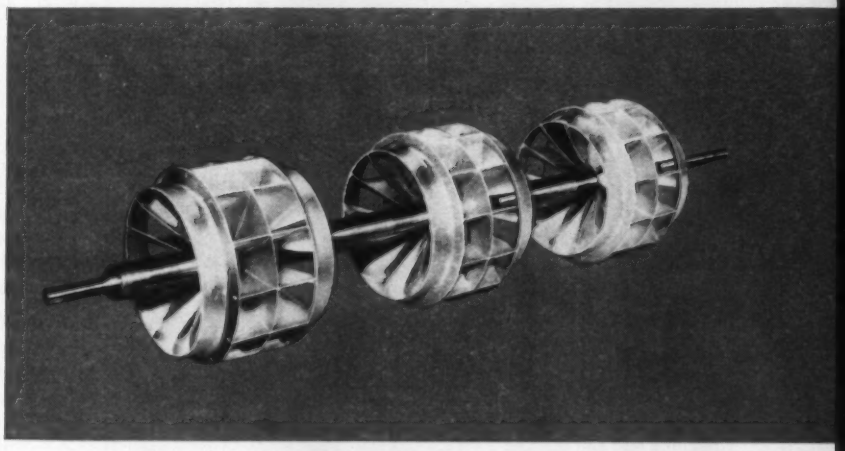

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- **. . . as easy to control as a ball point pen**
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- **. . . and *consistently* cleaner, smoother, more-uniform welds than any other process.**

See the next page for details.

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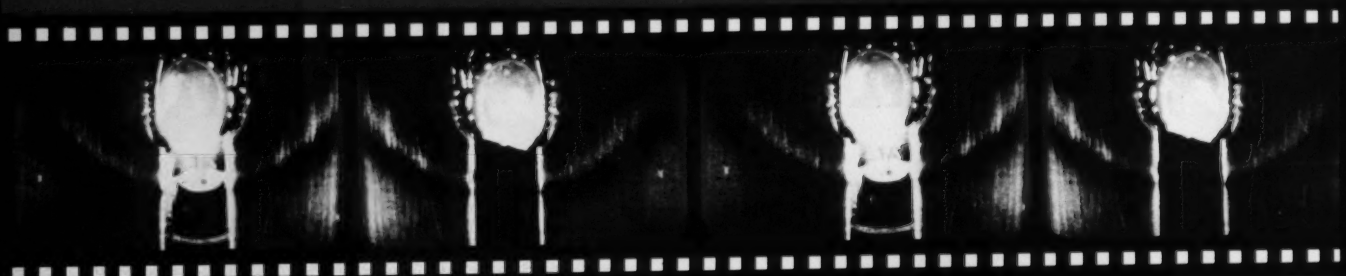
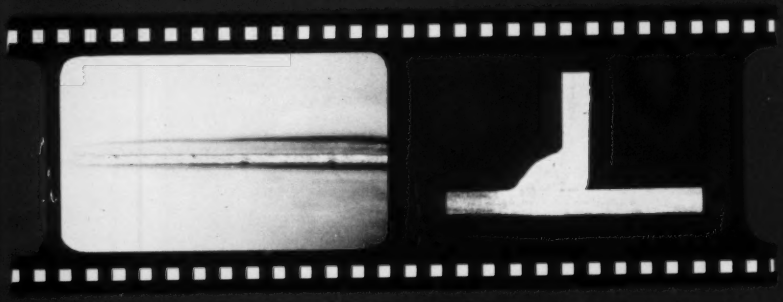


Here is a typical LINDE Short Arc weld in the making...



a finished bead, and a weld cross-section...

Notice the intermittent "shorting," the smooth, finished bead, the uniform penetration. No spatter. No clean-up. No finishing. Welders trained in minutes. Short Arc employs precisely controlled, low-voltage pinpoint-arcs shielded by an argon-CO_2 gas mixture. Shorting the arc lets the puddle cool, *minimizing* heat distortion and *controlling* burn-through for ideal penetration. Short Arc works on all common metals and their alloys, on carbon steel, stainless, aluminum and magnesium...on all types of joints...in all positions.

Only LINDE has brought together the ideal combination of materials for welding sheet metal—the SVI-300 power supply, with variable slope, voltage and inductance controls that permit an *infinite* range of settings; the C-25 argon-CO_2 gas mixture that combines with variable slope to reduce heat and control penetration; and the ST-2 and ST-4 torches, specially designed for hard and soft wires respectively. There is no substitute for Short Arc. Only LINDE offers the specialized equipment that makes such *quality* sheet-metal welding possible. For more information or a live demonstration, call your nearest LINDE office.

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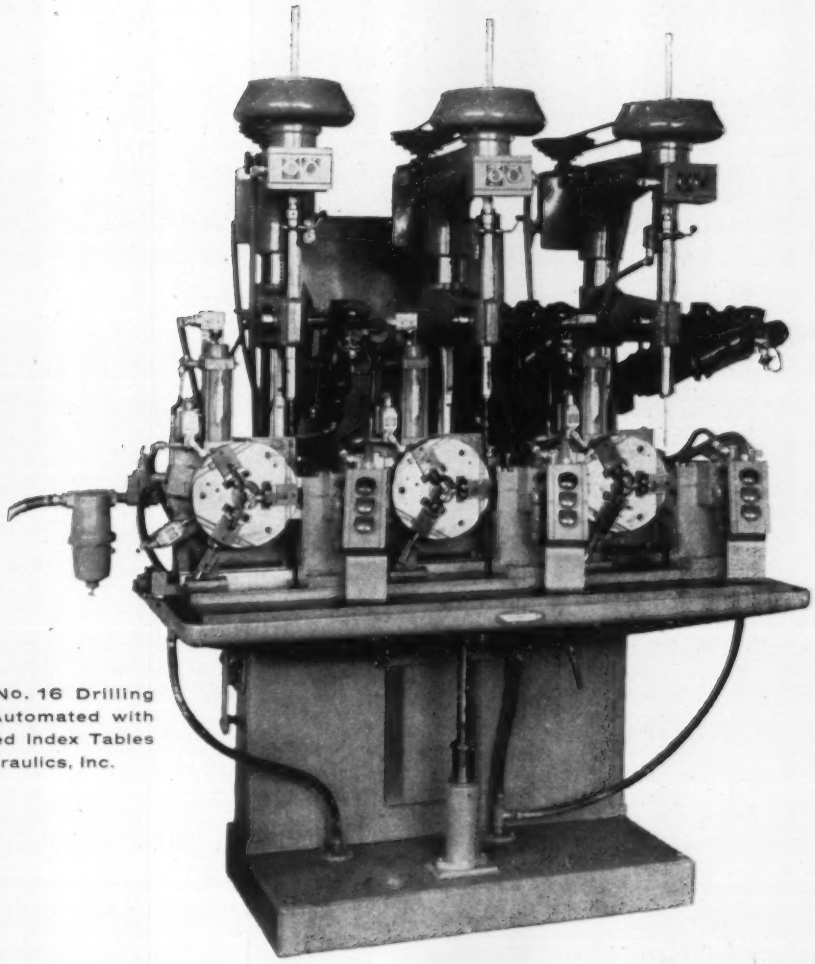

"Buffalo" No. 16 Drilling Machine Automated with Air-Operated Index Tables by Air Hydraulics, Inc.

8 YEARS OF SATISFACTION MADE THIS SALE!

Nothing sells a product like customer satisfaction. Here's proof:

Eight years ago a large mid-western manufacturer bought a "Buffalo" No. 16 Drilling Machine. It proved to be an excellent production machine. Quantity and quality of output were high. The No. 16 stood up to the punishment of continuous production with a minimum of maintenance.

This year the manufacturer decided to automate certain drilling and reaming operations. Because of eight years of complete satisfaction, a new 3 spindle "Buffalo" No. 16 Drilling Machine was specified.

The mechanism for automating the "Buffalo" Drill was designed and built by Air-Hydraulics, Inc. of Jackson, Michigan. Air-Hydraulics used its Model "H", 10" dia. Air-Operated Index Tables. The automated operation was drilling and reaming three lug-holes on the work piece.

The production rate was originally estimated at 150 pieces per hour. Air-Hydraulics reports that the actual production rate is 215 pieces per hour.

Here's a case of "three-way" satisfaction, with "Buffalo" Drills. Both the manufacturer and Air-Hydraulics are satisfied. And we are happy that our customer's satisfaction dictated the choice of a new "Buffalo" No. 16 Drilling Machine for this automation job.

For this kind of complete satisfaction, why don't *you* specify "Buffalo" Drills? Contact your "Buffalo" machine tool dealer, or write us direct for full information.

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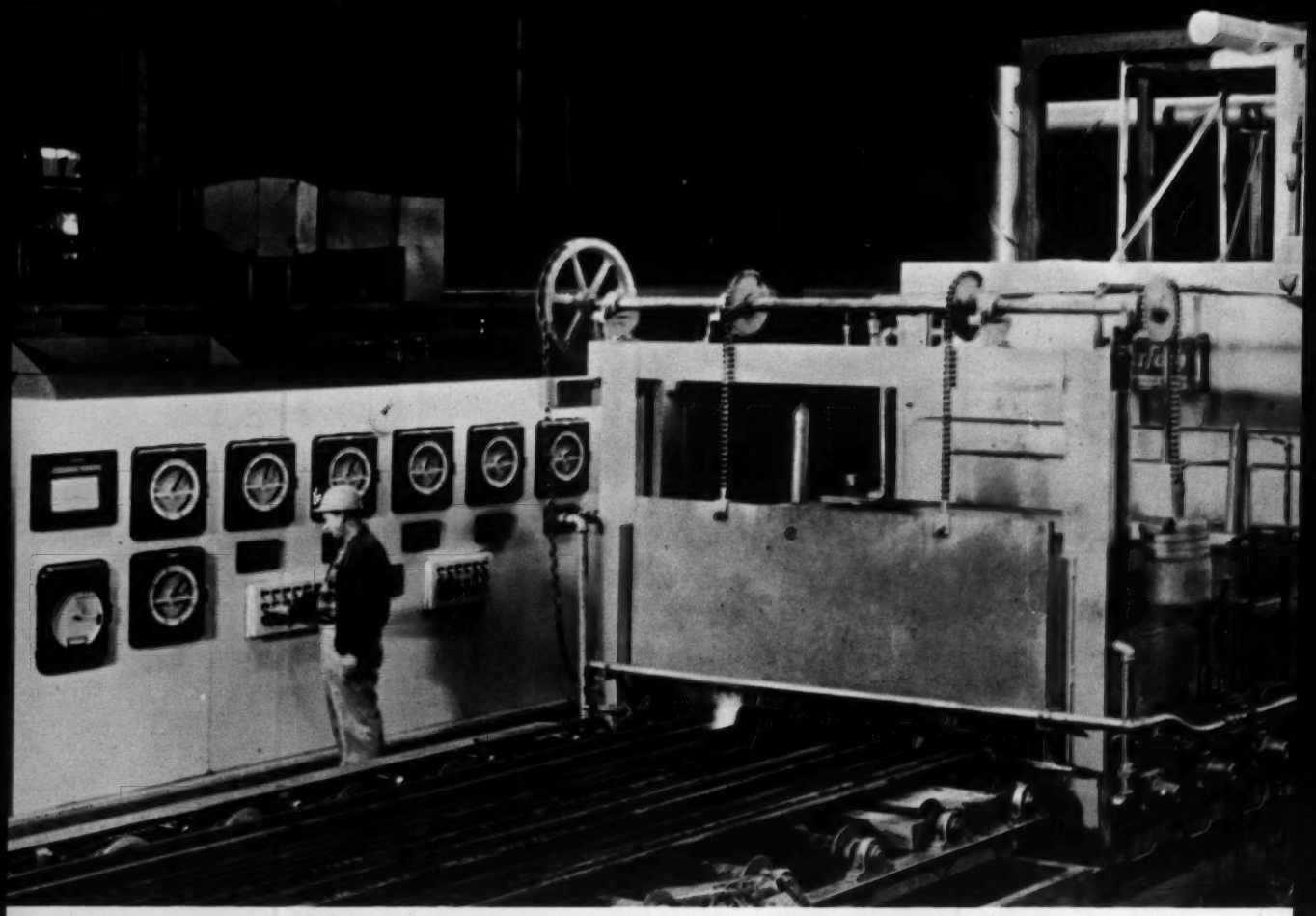

Carbon-restored bars emerge from controlled atmosphere furnace prior to cold drawing.

J&L announces industry's most modern controlled atmosphere furnace for cold finished bars

This new continuous controlled atmosphere furnace is the latest and most important addition to J&L's wide range of heat-treating facilities for cold finished bars. It makes possible a major increase in production of accurately and uniformly heat-treated cold finished bars – so important to producers of finished parts, who depend upon consistent properties throughout the bar, from bar to bar, and from shipment to shipment. The new furnace provides extremely accurate–yet flexible–control of heating and cooling. Flexibility is made possible by the division of the furnace into several automatically controlled chambers. Bars can thus be treated to match exactly each user's requirements for strength, hardness, and structure. These characteristics can be reproduced throughout different lots of steel. A principal function of the new furnace is carbon restoration annealing; other thermal treatments include bright annealing, spheroidize annealing, and normalizing.

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This Steelmark identifies products made of steel. Place this mark on your products. And — look for it when you buy.

Jones & Laughlin Steel Corporation

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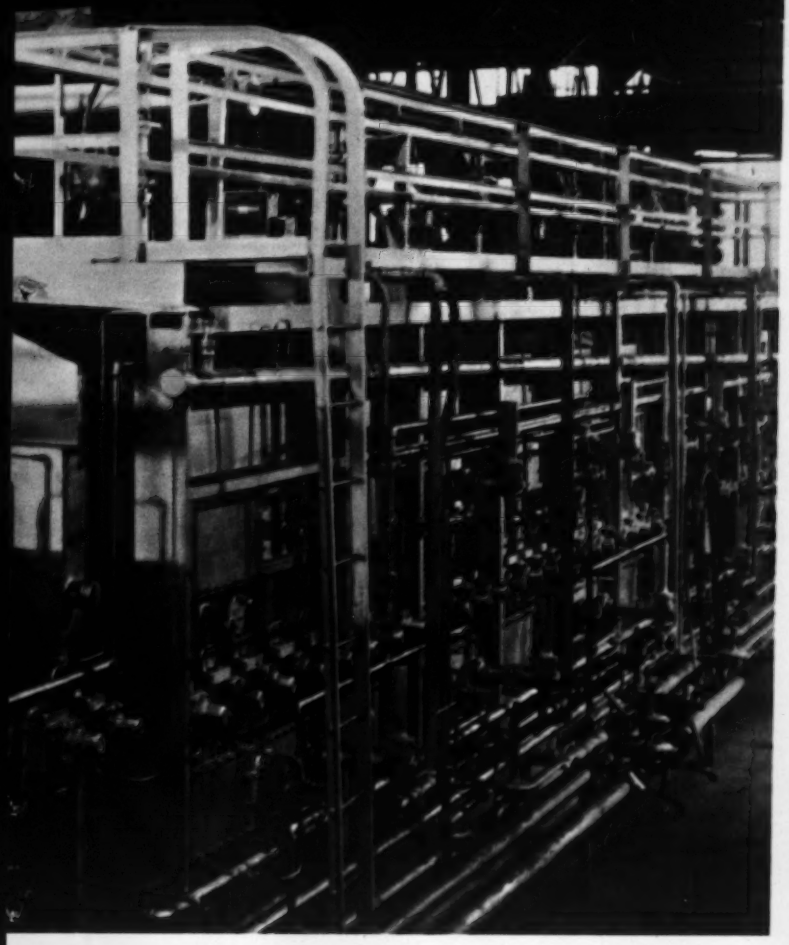
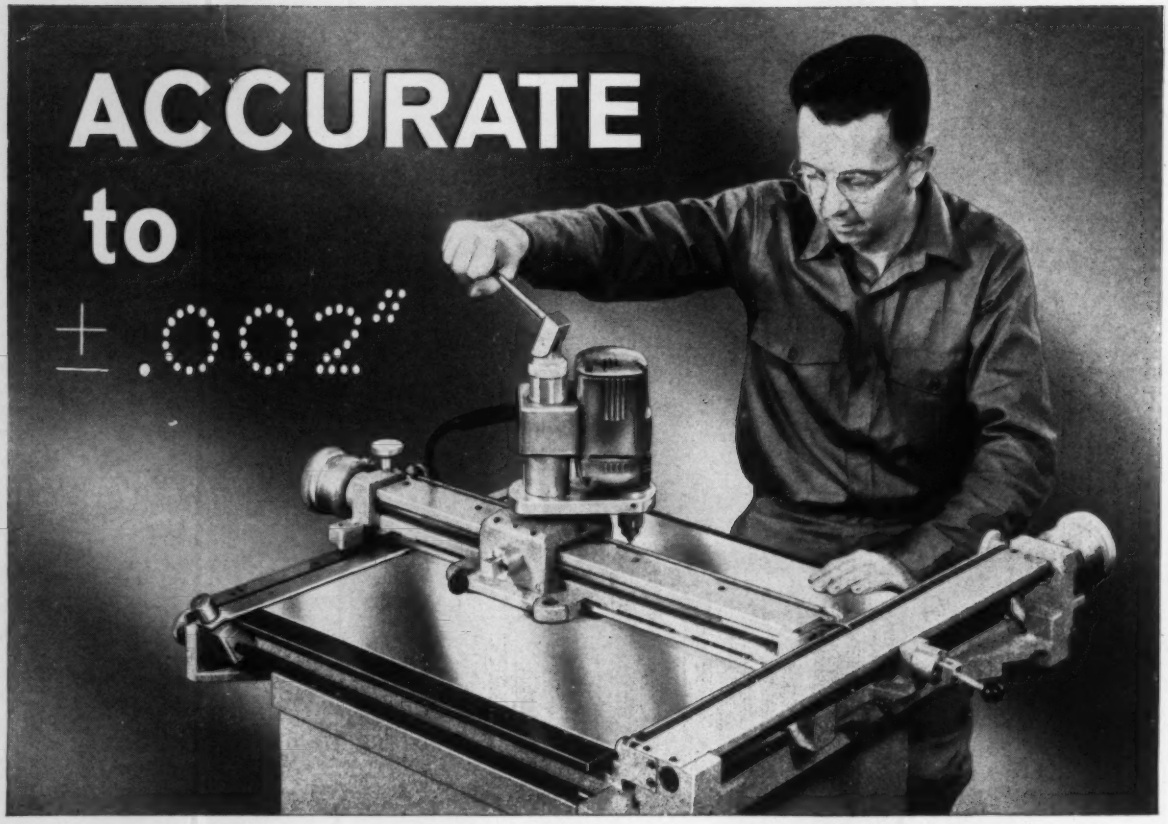


This new continuous controlled atmosphere furnace gives J&L greatly enlarged capacity for precision heat treatment of cold finished bar stock. Automatic control of furnace atmosphere, heating, and cooling results in a very uniform structure for the annealed bars.

Electreat is an exclusive J&L method of heat-treating cold finished bars by exceptionally accurate control of heating, quenching, and tempering. Individual bars are fed continuously through an induction coil, then quickly cooled and tempered to obtain desired mechanical properties or hardness. Electreat gives a high-strength bar with superior ductility and uniform hardness. Improved notch toughness enables parts to withstand shock loads in service; provides greater strength than conventionally heat-treated carbon steel at lower cost than alloy steel for many products.

New Holland Machine Company saves on drive shaft cost. By selecting J&L's Electreat C-1144 cold finished bars for the feeder drive shaft of a new hay baler, New Holland Machine Company met high standards for strength while saving money on the cost of the part. Electreat's high minimum yield strength (120,000 p.s.i. required in this case) and uniform hardness eliminated the need to use a larger diameter carbon steel shaft or an expensive alloy steel. Due to the high yield strength and uniform quality of Electreat, New Holland reports very satisfactory field performance from their shafts.

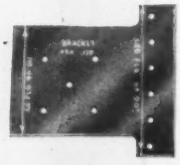


NEW STRIPPIT FLEX-O-DRILL

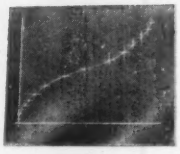
Are you looking for a way to reduce layout and template making time? Other manufacturers of sheet metal products and printed circuits have cut that time in half with the Strippit Flex-O-Drill.

This table-type, extremely accurate machine drills, reams, center punches and scribes *without* base line drawings or vernier height gauges. Positioning of the bridge and drill carriage is done with adjustable steel tapes calibrated to 0.100". Micrometric gauges then bring the setting to the nearest 0.001". Lead screws are precision ground and engaged only during micrometric gauge settings, thus speeding adjustment and minimizing wear. Capacity is ¼" mild steel—up to 24" width—any length.

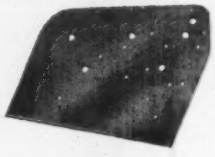
Anybody who can read blueprints and knows something about layout practice can learn to work the Strippit Flex-O-Drill in a few minutes. We'll be happy to prove this with an actual demonstration at your plant. Write for information today.



A typical Strippit Flex-O-Drill drilled template.



A typical Strippit Flex-O-Drill scribed layout.



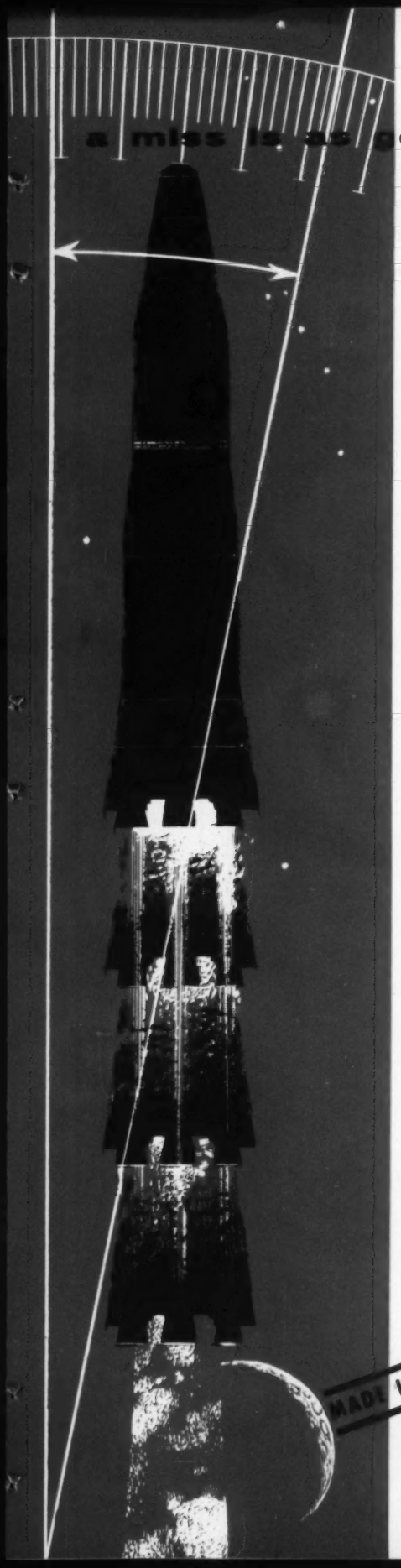
A typical Strippit Flex-O-Drill production piece.

WALES STRIPPIT INC.

210 Buell Road • Akron, New York

A UNIT OF HOUDAILLE INDUSTRIES, INC.

In Canada: Strippit Tool & Machine Company, Brampton, Ontario



a miss is as good as a thousand miles

the higher you aim
for new **productivity**
the more you need
Scovill's "count down"
on quality

SCOVILL®

brass
copper
aluminum

MILL PRODUCTS

MADE IN USA

. . . and made better to bring out the BEST in your products

SCOVILL MANUFACTURING COMPANY

Mill Products Division, 99 Mill St., Waterbury 20, Conn., Phone Plaza 4-1171

6SC60

SCOVILL® gives you fault-free metals for **high speed** fabrication

Advanced mill processes — Scovill pioneered the CONTINUOUS CASTING of Brass alloys to bring fabricators of Brass Mill Products the new standard of metal soundness and uniformity made possible by this unique process. Other more recent new mill installations at Scovill include precision-controlled Aluminum rolling mills; the advanced Sendzimir Mill for extra-close-tolerance sheet and strip; the World's largest vertical tube extrusion press, with automatic induction billet-heating equipment, as well as one of the Industry's newest and largest specialized tube mills.

Advanced quality-control procedures — insure dependable UNIFORMITY in all Scovill Mill Products specifications . . . order to order and lot to lot. They promise more accurately dimensioned, finer quality mill products essential to efficient high speed fabrication. Quality-control is a full-time job at Scovill, and the results are evident to fabricators in their own higher production speeds, minimum tool and machine adjustments and superior quality of finished products.

Advanced inspection equipment and methods — There are many inspection stations along each of the Scovill production lines for Brass strip and sheet, rod, wire and tube. In addition, samples of alloy billets and bars, as well as of finished mill products, undergo detailed inspection and test procedures in Scovill's Metals Research laboratories. Brass Mill Products that pass these rigid inspections and tests are considered by many to be the finest in the World.

Advanced packaging — Unique Scovill packaging methods protect quality, finish and condition, make it easier for fabricators to warehouse, handle and use Mill Products. Time- and cost-saving innovations such as extra-long-length coils of strip, self-feeding wire "dispenser" drums, special long lengths when required in tube mill products, are available to fabricators who need them.

Make Scovill a part of your competitive team, let us contribute our wealth of experience and ultra-modern equipment to the success of your NEW products and production plans.

SCOVILL MANUFACTURING COMPANY

Mill Products Division, 99 Mill Street, Waterbury 20, Conn. Phone PLaza 4-1171

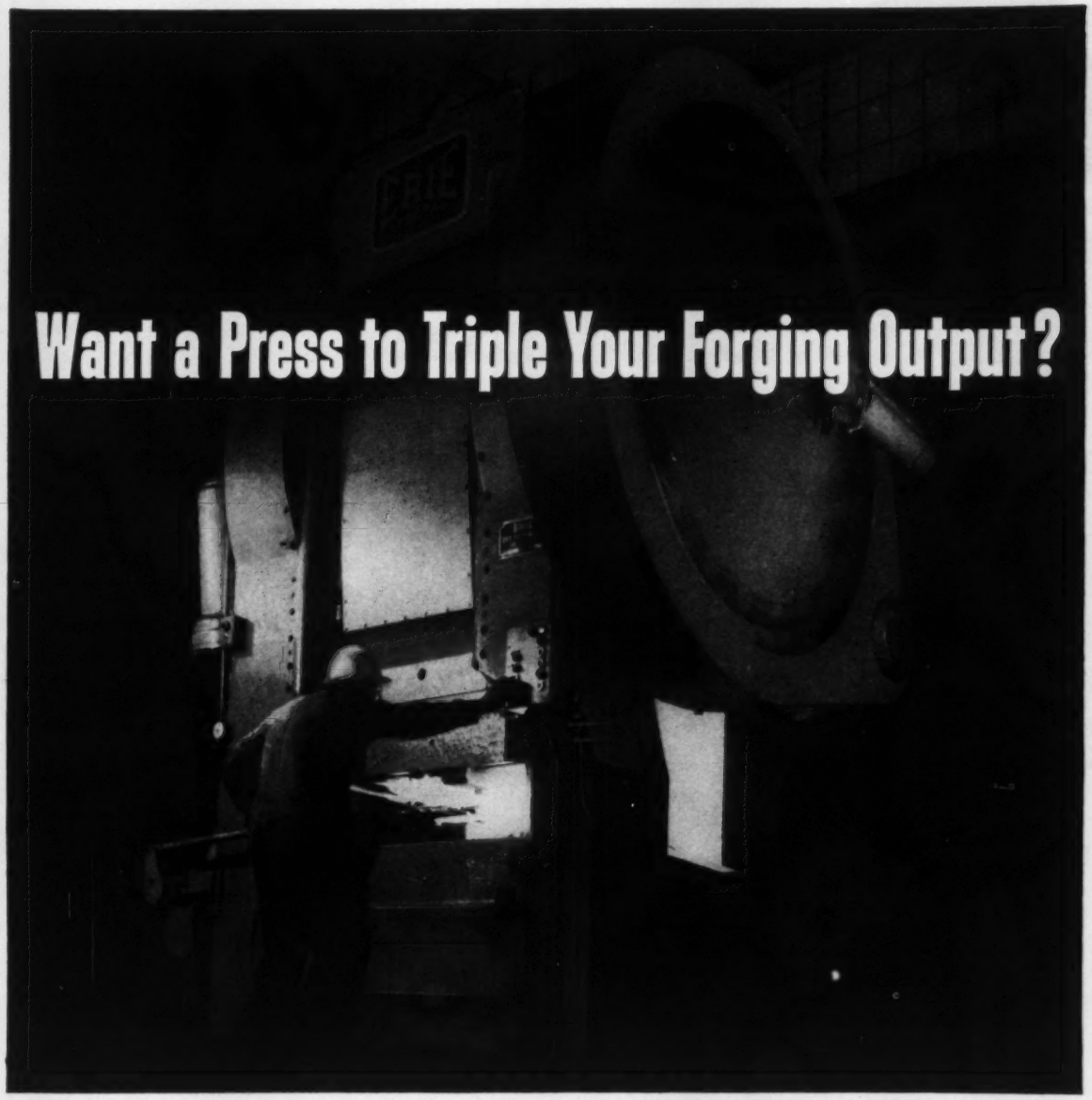
MADE IN USA

. . . and made better to bring out the BEST in your products

7SC60

MILL PRODUCTS

Want a Press to Triple Your Forging Output?



We'll build the press for all your forging requirements . . .

Tell us your forging problems and give us your production specifications—we'll do the rest.

Erie Foundry, one of the first companies to automate forging, can provide specially designed *high volume* presses in capacities of 1000 to 8000 tons. Instead of the three machines and nine men formerly required, now you need only one Erie automated forging press and only one operator observer—to triple your present production rate! Trimming, too, can be accomplished in a single production cycle. With billet supply and finished part removal conveyorized, it is possible to achieve a production volume of, say, 1200 track-link forgings per hour.

Erie Foundry has a complete line of machines designed for high volume production of such parts as connecting rods, gear blanks, automotive and tractor valves, pinions, track links and wheel hubs.

We would like to discuss application of automated presses to your production requirements. For the complete story, phone or write Mr. R. E. Sanford, Erie Foundry Company, Erie 2, Pa.

ERIE

ERIE FOUNDRY CO.

The world's great name in forging since 1895 EF-59-01

HOW DO YOU WELD STAINLESS?

With stick electrodes?..by gas shielded metal arc welding (Aircomatic®)?..by gas shielded tungsten arc welding (Heliweld)?

Airco supplies electrodes or wire for *all three*, can give unbiased advice, broad selection. Are the stainless steels that you weld light gauge or heavy . . . martensitic, ferritic or austenitic . . . subject to heat, corrosion or stress? Whatever the application, Airco supplies electrodes or wire to weld them *better*.

For stick electrode welding: choose from 36 Airco Stainless Electrode types. They give you high welding speed with low heat input. Welds are smooth, spatter is minimal, cleaning and polishing are easy. Bonus: electrodes are protected in Airco's exclusive resealable "POP" can; it keeps them factory-fresh down to the last electrode.

For inert gas shielded processes: depending on application, you'll choose either AIRCOMATIC® gas shielded metal arc welding—or Airco's HELIWELD gas shielded tungsten arc welding. For both of these processes, Airco Stainless steel welding or filler wire gives excellent corrosion resistance and excellent tensile, ductility and impact properties.

Which is best for you? Call Airco for an unbiased answer—for *only* Airco makes equipment for all three processes. Look in Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Authorized Airco Distributor. Write today for a copy of Airco's "Electrode Pocket Guide" and "Aircomatic Welding Wire Pocket Guide."

AIRCO®

AIR REDUCTION SALES COMPANY

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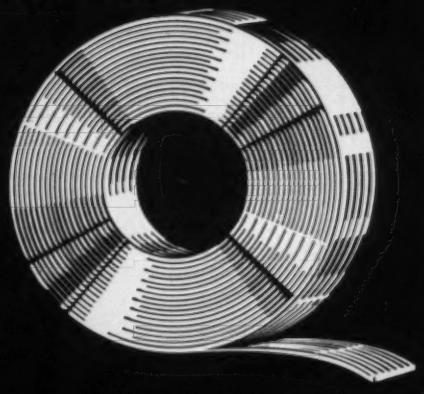
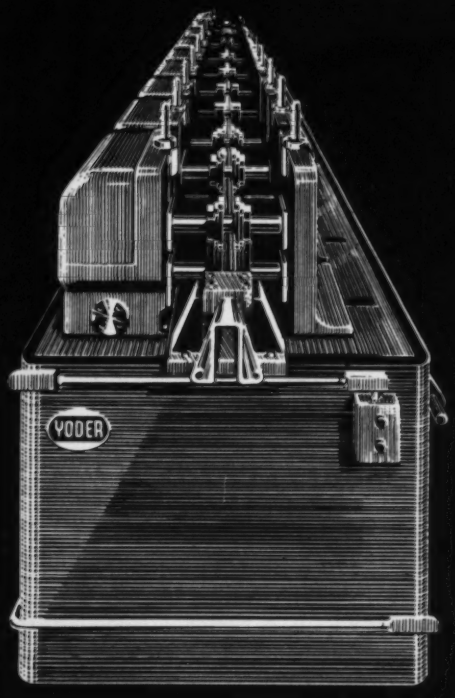
... from start





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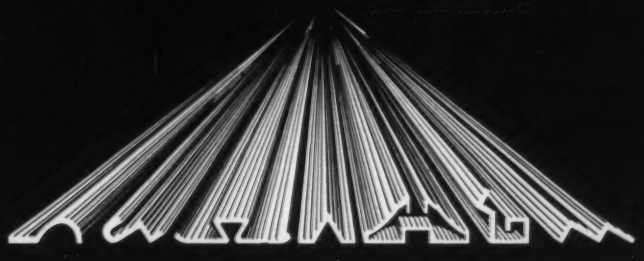

COLD ROLL-FORMING EQUIPMENT

PIPE AND TUBE MILLS (ferrous or non-ferrous)
ROTARY SLITTING LINES

YODER ROLL-FORMING EQUIPMENT

Profits are available to you through the production of many shapes in metal... made with precision and economy on Yoder Cold Roll Forming Equipment.

Produce tubular, ornamental or structural shapes from a variety of metals in widths from a fraction of an inch up to 80 inches or more, and in stock up to ¾" thick. Your investment is comparatively modest, and with proven low operating costs, will give you one of the most profitable operations in your plant.

Experienced Yoder engineers will, without obligation, study your annual metal forming requirements. Many times they can point out that the installation of roll forming equipment would—even if operated only intermittently—soon justify its initial cost.

Send today for this comprehensive, 88-page illustrated text. It fully describes Cold Roll Forming Equipment, processes and products.

THE YODER COMPANY
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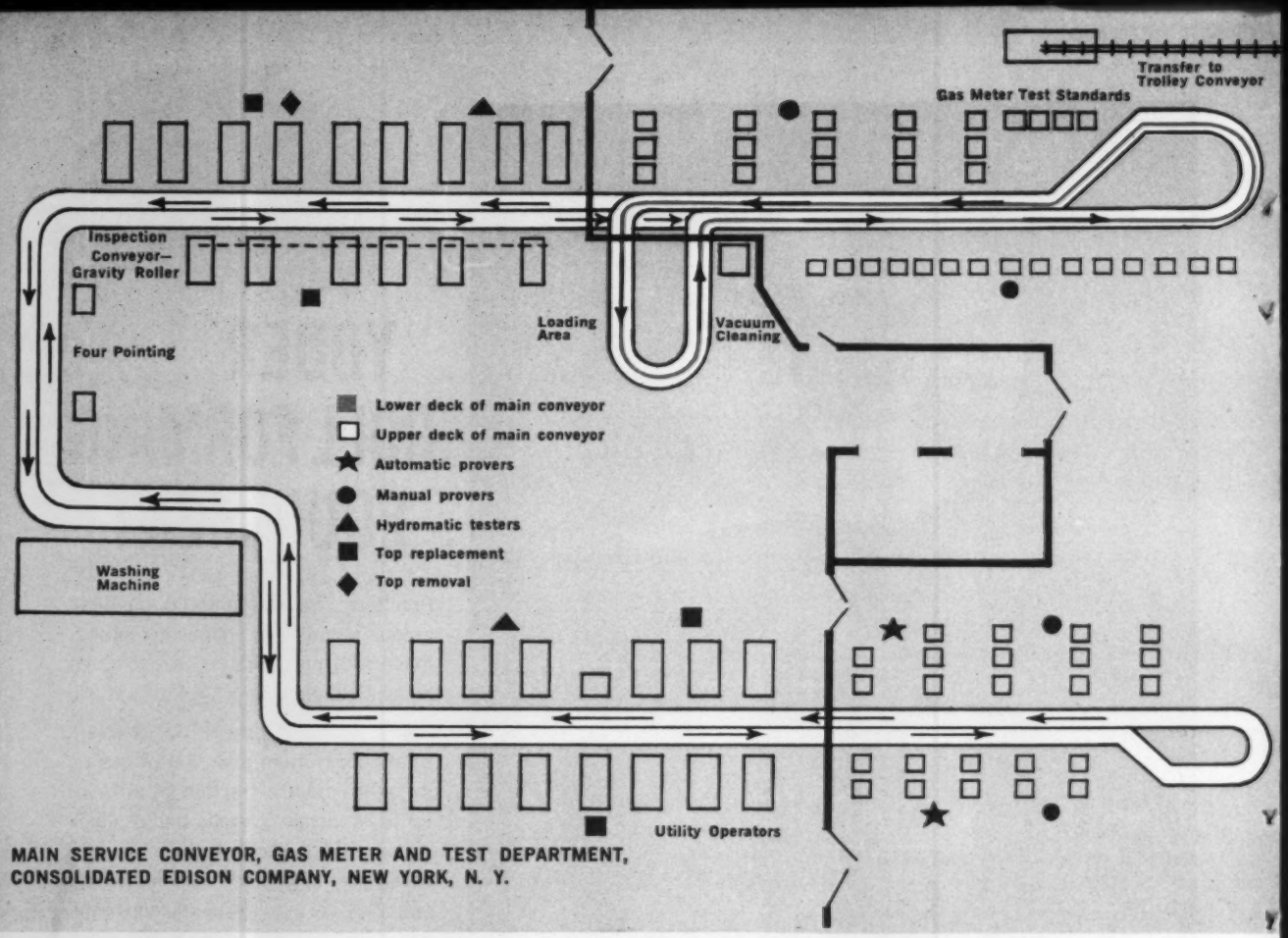
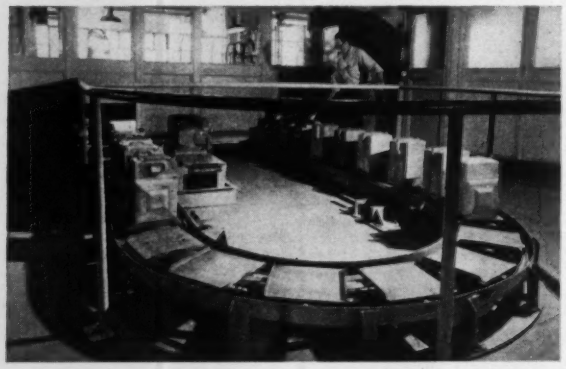


MAIN SERVICE CONVEYOR, GAS METER AND TEST DEPARTMENT, CONSOLIDATED EDISON COMPANY, NEW YORK, N. Y.

Logan *Plant Dynamation* System

pays for itself in 1 year at Consolidated Edison

Loading area, where incoming meters are placed on the 202-ft. lower deck of the main service conveyor. Both decks are carousel type, chain-on-edge driven conveyors. Specially designed individual carriages hold one larger-type meter, shown here, two of a smaller type also serviced.



When 1200 feet of chain, trolley, belt, and roller conveyors pays for itself in a single year, usually the reason is better engineering. Consolidated Edison Company, New York, N. Y., enthusiastically supports this explanation of the success of the Logan system installed in its Gas Meter Shop in mid-1959.

From the first planning stages, the Logan Plant Dynamation specialist collaborated with Consolidated Edison on the ingeniously simple conveyor system and revised department layout shown here. The system mechanizes work flow on scheduled maintenance checks of about 4,000 gas meters per week. Meters previously were moved through the department by hand-truck.

Benefits and savings are reduced labor costs, space savings, continuous production, new versatility to meet shifting needs, minimized damage to meters, better safety conditions and reduced fatigue for workers. The conveyors have required no maintenance other than periodic lubrication and servicing.

Here the double-decked portion of the main service conveyor carries meters through an incoming test section. A tag applied here designates service steps to be performed as each meter carousels through the shop. Any incoming test bench and worker can be switched to final testing or meter adjusting, when relative work loads so dictate.

One end of the two elongated merry-go-rounds, seen from the trolley conveyor transfer point. Since the conveyor is a moving work bank for the individual benches, a meter may pass this point more than once before being transferred from the lower deck to the upper deck or out of this system to the trolley conveyor.

Dispersal and de-specialization of work proved to be surprise keys to the dynamics of numerous bench-work steps performed on the meters. Incoming meters are removed from the lower section of the double-deck main service conveyor, tested, then placed on the 720-ft. upper deck. This conveyor loops continuously among all the work bench areas. However, each step is performed at two or more separate points. Thus, meters are removed and replaced a few at a time, eliminating lengthy waits. Frequently-varying needs are met by certain benches and workers prepared to perform any of three steps on demand.

A tag system designates steps required on each meter. The meters are continually moved back and forth between the benches and main conveyor, but all handling is at one convenient level once meters have been placed on the upper deck.

After internal servicing, a 240-ft. continuous trolley conveyor takes the meters down two floors, through a degreasing installation and a paint booth. They are re-sealed on a final section of Logan belt conveyor, which carries them to shipping.

Logan conveyor design helps harness all the work power potential of your plant

A number of different conveyor systems might pace your process "efficiently." However, between the *least* efficient and the *most* efficient of these, many thousands of dollars can be gained annually in bigger output and lower costs.

The Logan technique of Plant Dynamation eliminates hit-or-miss from conveyorizing. The Logan engineer helps you analyze your operation's *basic work-power patterns* . . . then moves step by step to design the *one right* system dictated by these patterns.

Over the half-century in which assembly-line production itself has grown up, Logan engineers have developed and proved their exclusive Plant Dynamation technique through thousands of custom installations. On an average, "The Man From Logan" stationed in your area has participated in fourteen years of this vital experience.

One of the most comprehensive lines of conveyor equipment permits the Logan engineer to specify freely. Both as supplier and designer he commands five distinct modes of power and control: gravity, electricity, hydraulics, pneumatics, and electronics. Every "Man From Logan" has made original contributions to the concept of automation.

"The Man From Logan" stationed near you is quickly available. It pays to include him in the early sessions of new-plant or plant-revision planning. And he works directly with your engineers through installation to smooth operation. Write or phone today for a conference with this specialist in Plant Dynamation.

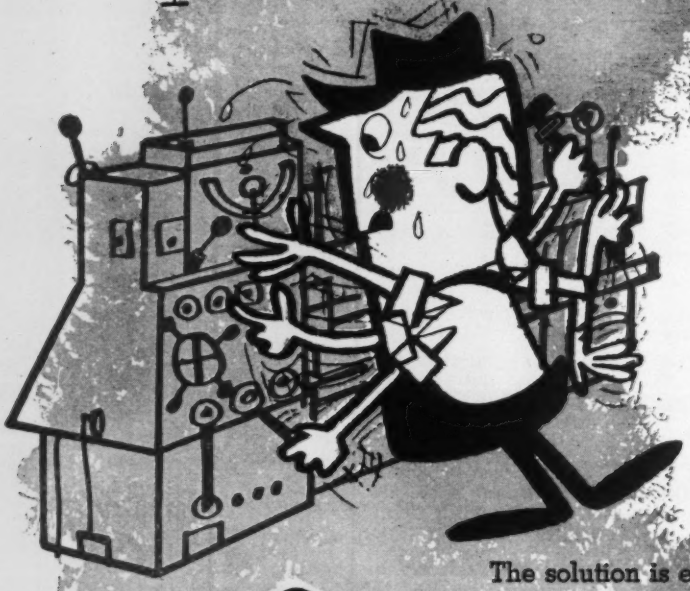
Logan Conveyors

LOGAN CO., 535 CABEL ST., LOUISVILLE 6, KY.

STOP

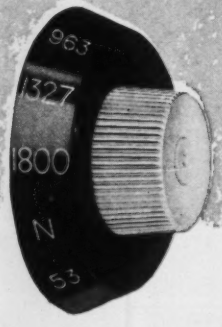
these men from stealing your profits.....

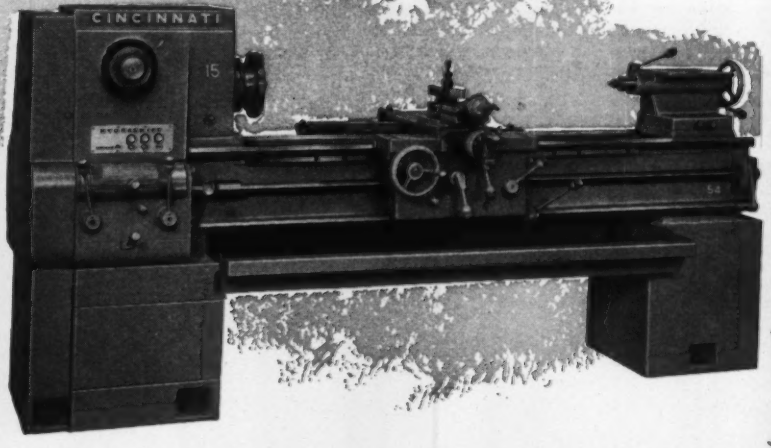
You know about this fellow . . . he's stealing "cash", and you do try to stop him.



But **YOU** cause this theft . . .
you force this man to steal your profits . . .
make him add to labor and burden costs on most lathe jobs, no matter how hard he works.

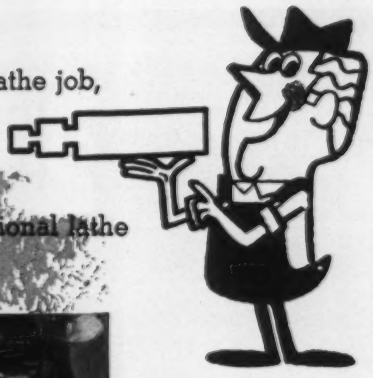
The solution is easy:
make your operator a *cost-reducer* on ALL of his lathe jobs—shift him to HYDRASHIFT * Here's why.....



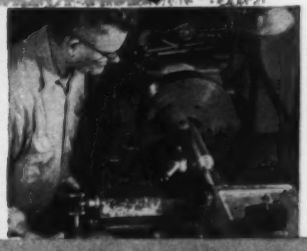


*HYDRASHIFT is Cincinnati's new lathe line with *the new way to change spindle speeds . . . hydraulically!*

Compare the machining of this typical lathe job, two steps and two necks on the new HYDRASHIFT . . . on a conventional lathe

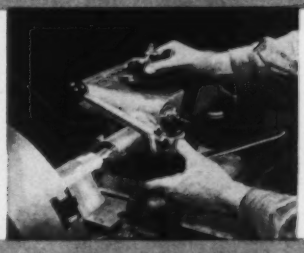


As second step is being cut, operator turns the dial to speed required for the necking cut.



Operator waits for machine to complete the step cuts.

Step cuts completed, operator changes to necking tool (he had it lying on the convenient Tray-Top) and positions tool for cut.



Step cuts completed, operator changes to necking tool and positions tool for cut.

Operator engages spindle lever and cuts the neck—*without leaving apron.*

Operator goes to headstock, shifts various levers to change to spindle speed for necking cut.

Necking cuts completed, operator changes tools for next workpiece.

Operator returns to apron, engages spindle lever, and cuts the neck.

Don't force your lathe operators to steal profits from your pockets—take a look at the new Cincinnati HYDRASHIFT Lathes at your nearby Cincinnati Lathe and Tool Dealer's showroom. If you can't reach him immediately, wire collect!

CINCINNATI LATHE AND TOOL CO. CINCINNATI 9, OHIO

HYDRASHIFT Lathes/CINCINNATI Drilling Machines/SPIROPOINT Drill Sharpeners

Your final steel cost must include both

What goes into *final* cost of steel? Maybe more than you realize. After you know the initial price, figure the further costs of possession. Often hidden and unnecessary, they include the costs of storing, handling and readying your steel for use. Costs your steel service center can often help you reduce or eliminate—to keep your steel costs *low*.

Each steel user's case is different. Ask your steel service center to help you determine the most economical way to buy steel. They will give you a helpful guide for figuring all your costs of possession, such as:

Cost of capital:	Cost of operation:	Other costs:
Inventory	Space	Obsolescence
Space	Material handling	Insurance
Equipment	Cutting & burning	Taxes
	Scrap & wastage	Accounting

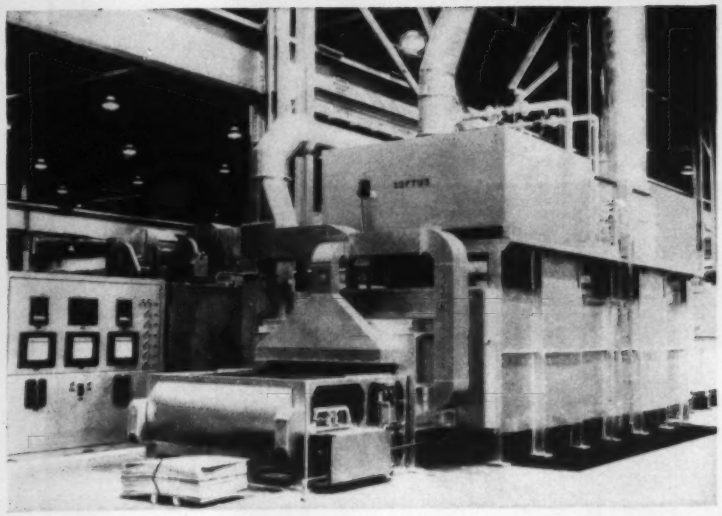
Call your nearby steel service center, or write for free booklet, "What's Your Real Cost of Possession for Steel?"

STEEL SERVICE CENTER INSTITUTE

...YOUR STEEL SERVICE CENTER

Steel

STEEL SERVICE CENTER INSTITUTE
540-A Terminal Tower, Cleveland 13, Ohio



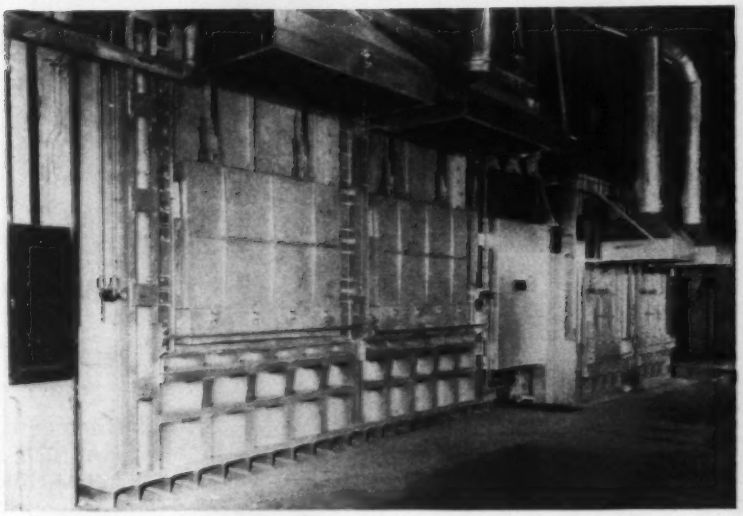
LOFTUS *Aluminum* FURNACES

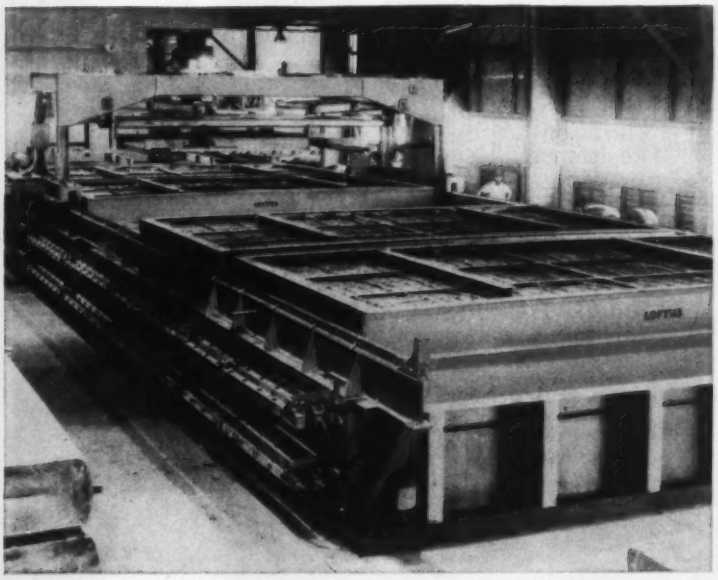
for
melting, holding,
reheating, annealing,
homogenizing

The many repeat orders for Loftus furnaces are the best evidence of customer satisfaction. Loftus furnaces offer:

- **High Production**
- **Economical Operation**
- **Low Maintenance**
- **Rugged Construction**

Whether building or expanding, you too can benefit from the wealth of experience available from Loftus.





Loftus custom-builds complete plants and specializes in furnaces of all types and sizes for both ferrous and non-ferrous metals. Whatever your requirements, it will pay you to call on the engineering and construction know-how developed by Loftus over more than two decades of service to American metal producers.

From first heat to heat treat, look to

LOFTUS
Engineering Corporation

1 Gateway Center, Pittsburgh 22, Pa.

60.15.3

Alcoa Alloy 6262-T9*—another Alcoa first—promises to become a standard in the screw machine products industry

*Patent applied for

a comparison of the characteristics of ALCOA SCREW MACHINE STOCK ALLOY 6262-T9 with other ALUMINUM SCREW MACHINE STOCK ALLOYS

	6061-T6	2017-T4 and 2024-T4	2011-T3
Strength	better	better(1)	better
Machinability	better	better(2)	not as good
Corrosion Resistance	same	better	better
Finishing Characteristics	same	better	better

(1) Based on Yield Strength
(2) Depends on Method of Machining

RELATIVE CHIP SIZE RATING
2011-T3: 1.0 6262-T9: 1.4 2017-T4 and 2024-T4: 2.0—3.0 6061-T6: 4.0

Visit the Alcoa exhibit, Booth 1410, National Metals Exposition, Philadelphia, Pa., October 17-21, 1960.

[redacted]

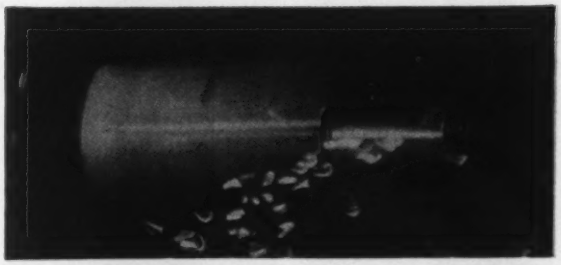
ALCOA'S NEW ALLOY 6262-T9 IS EXPECTED TO REPLACE ALLOY 6061 ENTIRELY AND 2017, 2024 IN MANY APPLICATIONS.

DESIGN ADVANTAGES—Higher typical properties (58,000 psi tensile strength, 55,000 psi yield strength, 10 per cent elongation) than 2011, 2017, 2024 and 6061—better corrosion resistance and finishing characteristics than 2011, 2017 and 2024—not subject to stress corrosion cracking.

ECONOMIC ADVANTAGES—Buyers can reduce inventories—stock one or two alloys instead of four—streamline purchasing—order in larger quantities.

PRODUCTION ADVANTAGES—Better machinability than 2017, 2024 and 6061.

For complete information, specifications, delivery of the newest aluminum screw machine stock alloy—Alcoa 6262-T9—call your nearest Alcoa sales office, or distributor, or write: Aluminum Company of America, 845-K Alcoa Building, Pittsburgh 19, Pa.



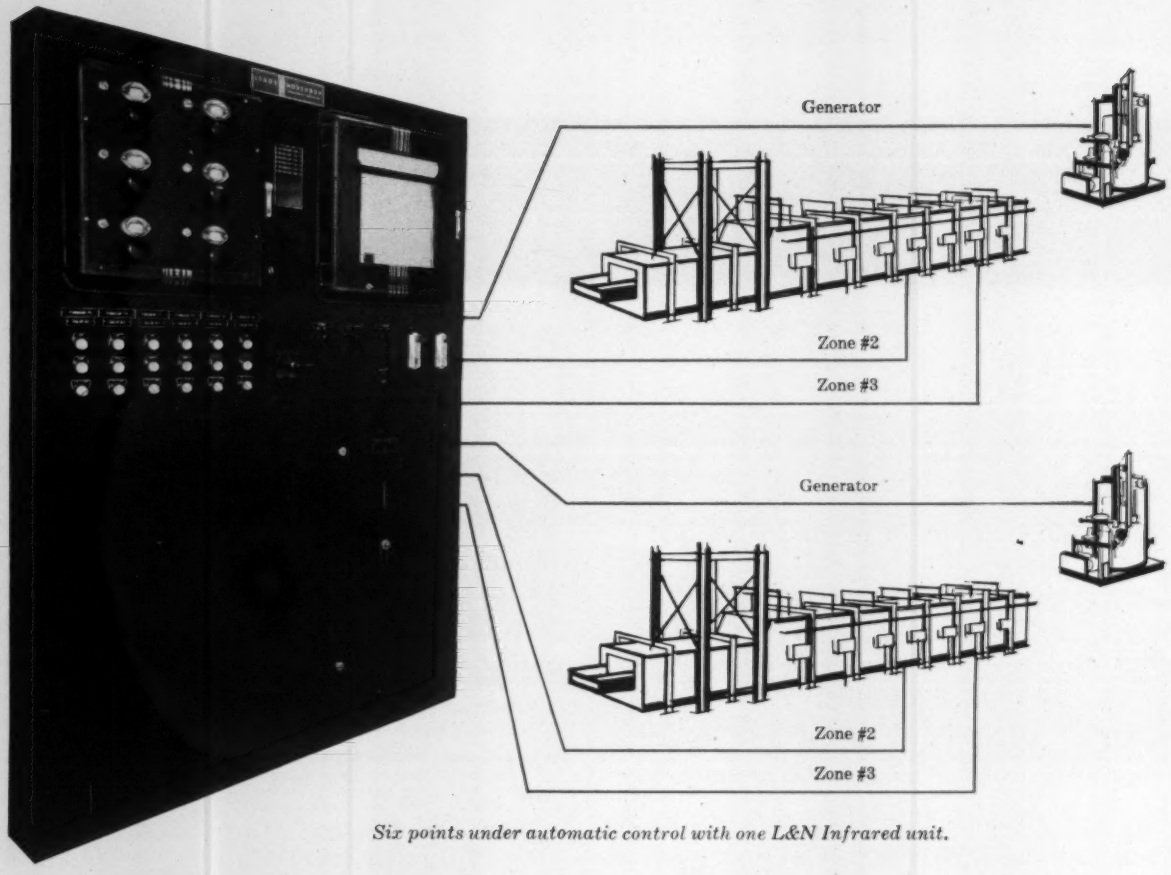
HIGHER STRENGTH—6262 offers higher strength than alloys 2011, 2017 and 2024.

BETTER CORROSION RESISTANCE—6262 offers better corrosion resistance and finishing characteristics than alloys 2011, 2017 and 2024.

BETTER MACHINABILITY—6262 offers better machinability and higher strength than alloy 6061 . . . corrosion resistance and finishing characteristics comparable to 6061.

ALCOA ALUMINUM

SCREW MACHINE STOCK



Six points under automatic control with one L&N Infrared unit.

New L&N Infrared Analyzer Package automatically holds furnace and generator atmospheres "in line"

The L&N IR Analyzer equipment for automatic control of heat treating atmospheres offers five outstanding advantages.

- *It is rugged, reliable and easy to operate.*
- *It is a completely assembled package with all necessary "hardware" panel mounted, piped and wired.*
- *Each unit may be calibrated for either CO, CO_2 or CH_4.*
- *Calibration is accurate and positive . . . requires only three minutes, on-the-spot.*
- *Generator and furnace atmospheres of as many as six points taken from any location in your heat treat can be controlled by one unit.*

This new package of the time-proven L&N IR Analyzer, designed specifically for metallurgical use, is now automatically controlling atmospheres in a number of well known metalworking plants. It has earned the respect of management and operating personnel alike for its accuracy, dependability and ease of maintenance.

For more information request Folder N-91-620(1) from your nearest L&N office or write 4957 Stenton Ave., Phila. 44, Pa.

LEEDS Instruments LN NORTHRUP Automatic Controls · Furnaces

ALCAN extrusion ingot gives you these 4 dollar-saving advantages!

1. Better finish! 2. Greater extrudability! 3. Higher recovery! 4. Longer die-life! . . . four important reasons why ALCAN extrusion ingot may be far more economical than the billet you're now using!

How much will this better quality billet save? For an exact answer test-run ALCAN billet on your own equipment. Carefully measure its performance and true cost. See how much easier and faster it extrudes. How it reduces scrap and lengthens die-life. How it actually makes a difference in the quality of your finish.

From mining to casting—countless checks on quality make ALCAN the finest of all billet products. It is made entirely of clean, primary metal . . . unexcelled in internal structure and surface smoothness . . . and cast to the industry's closest tolerances.

Telephone our nearest office today about testing ALCAN billet on your own equipment! We welcome the opportunity to show you the difference it can make in your extruding costs and productivity.

Aluminium Limited

ALCAN

Ingot Specialist...serving
American Aluminum Fabricators—

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Additional distribution (Alcan Foundry Alloys):
Apex Smelting Company, Chicago, Cleveland, Los Angeles
Aluminum Inc., Fort Lauderdale, Florida

Dann Goodson, *Manager Motor-Driven Compressor Sales, The Cooper-Bessemer Corporation, explains...*

How Cooper-Bessemer's new, compact Air Compressors simplify installation and reduce costs

The DMR compressors shown here are two models of a new line of *compact, 720 rpm* machines, unmatched in reliability. With these units, Cooper-Bessemer introduces a new standard of installation economy. So highly compact, the DMR compressors are readily installed in existing space, avoiding the need for additional housing facilities. They can be located at strategic points throughout the plant to supplement existing air line services without additional feeders to help supply your production needs at minimum cost.

The new DMR units come completely equipped with integral motor-drive and intercooler... ready for operation. Their control can also be integrally mounted as shown. They are available for two-stage applications in the range of 500 to 2000 cfm and discharge pressures of 80 to 125 psi... also for single-stage and three-stage operation.

The introduction of this new line of air compressors, plus the portable tool facilities of our new subsidiary, The Rotor Tool Company, enable Cooper-Bessemer to give you full-scope service for your industrial air power needs. Call the nearby Cooper-Bessemer office or air compressor agent for Bulletin No. 94 on the new DMR line.

BRANCH OFFICES: Grove City • New York • Washington • Gloucester • Pittsburgh
Chicago • Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport
Houston • Greggton • Dallas • Odessa • Pampa • Casper • Seattle • San Francisco
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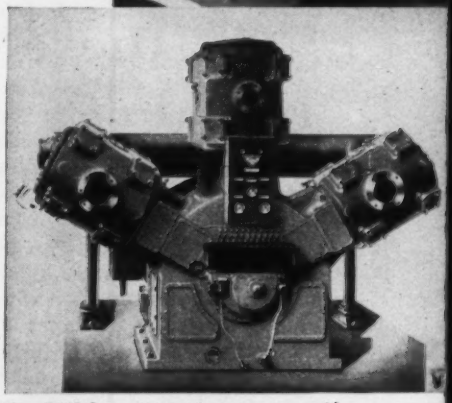
SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary
Toronto • Halifax • Stratford
C-B Southern, Inc.... Houston
Cooper-Bessemer International Corp.... New York • Caracas • Anaco
Cooper-Bessemer, S.A.... Chur, Switzerland • The Hague, Netherlands • Mexico City
The Rotor Tool Company... Cleveland

Cooper Bessemer

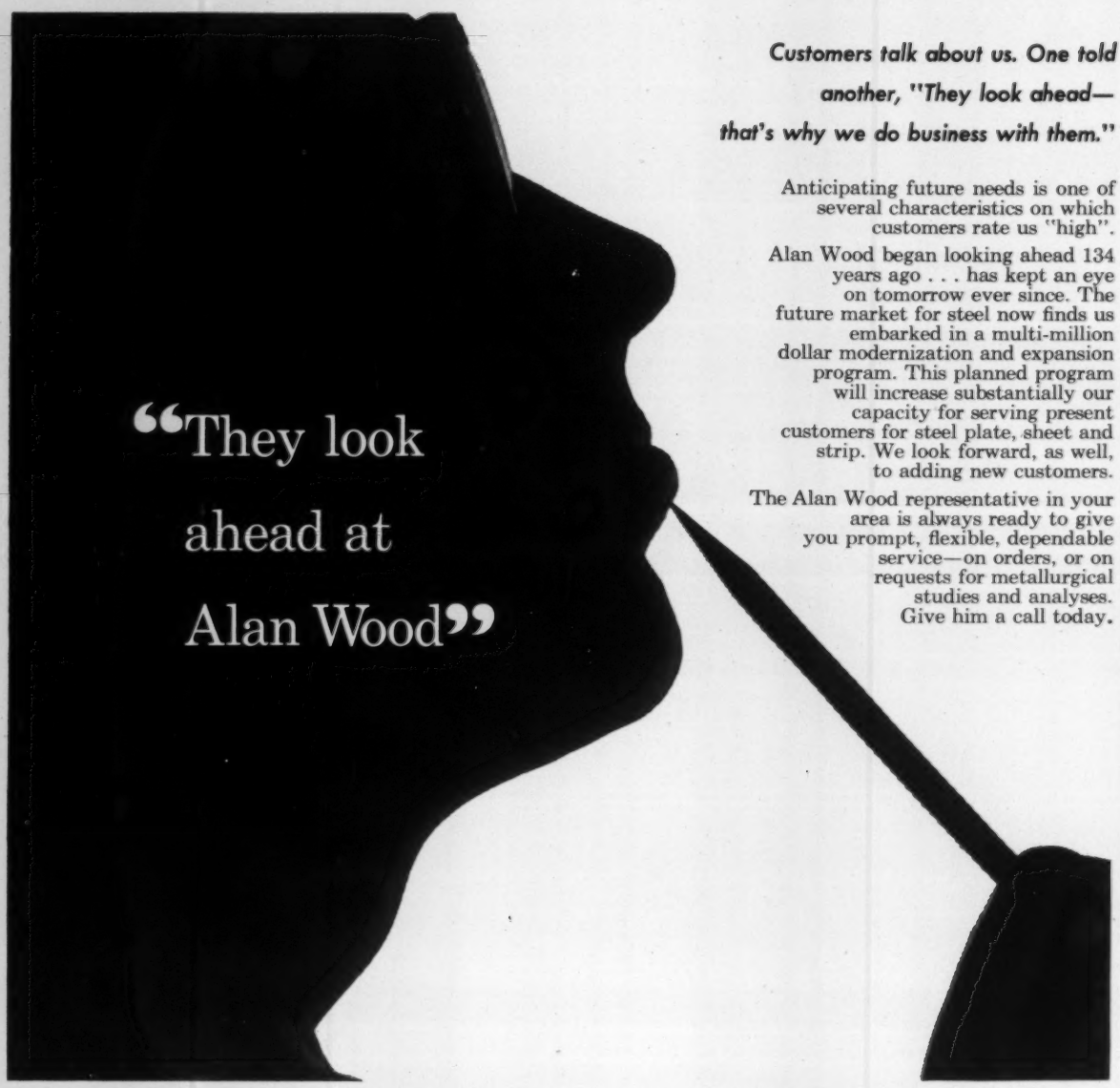
GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, TURBINE OR MOTOR DRIVEN



New DMR-3 two-stage air compressor with integral control. Ratings of 300-350 hp.

NEW
COOPER-BESSEMER
DMR-2 TWO-STAGE
AIR COMPRESSOR
WITH
EN-TRONIC CONTRO
100 TO 250 HP



Customers talk about us. One told another, "They look ahead—that's why we do business with them."

Anticipating future needs is one of several characteristics on which customers rate us "high".

Alan Wood began looking ahead 134 years ago . . . has kept an eye on tomorrow ever since. The future market for steel now finds us embarked in a multi-million dollar modernization and expansion program. This planned program will increase substantially our capacity for serving present customers for steel plate, sheet and strip. We look forward, as well, to adding new customers.

The Alan Wood representative in your area is always ready to give you prompt, flexible, dependable service—on orders, or on requests for metallurgical studies and analyses. Give him a call today.

ALAN WOOD STEEL COMPANY

Conshohocken, Pa. • **STEEL PRODUCERS WITH THE CUSTOMER IN MIND**

DISTRICT OFFICES AND REPRESENTATIVES: Philadelphia • New York • Los Angeles • Boston • Atlanta Cincinnati • Cleveland • Detroit • Houston • Pittsburgh • Richmond • St. Paul • San Francisco • Seattle Montreal, Toronto and Vancouver, Canada: A. C. Leslie & Co., Limited

New high-temperature furnace for brazing alloy assemblies solved space and work handling problems for an aircraft engine manufacturer.

HEAT
from General Electric

How General Electric furnace innovation keeps pace with your product progress

Progress in the art of furnace design and manufacture can be vital to the future progress of your business. Recent innovations by General Electric promise tremendous savings to any industry which includes heat treating in its processes.

Example: Jet cooling, developed by General Electric, now permits increased furnace output and up to 30 percent reduction in floor space for annealing furnaces. New design gives faster cooling of light-gage strip.

Example: A new muffle-less furnace for bright brazing of stainless steel has saved one customer $45,000 in a single year in muffle replacement costs and downtime.

Example: New General Electric radiation shield furnaces give faster heating and cooling cycles than hot retort furnaces. The new furnaces are used with vacuum, or inert or hydrogen atmospheres up to 4200 F.

Next time you're modernizing or adding to your heat treating line be sure to call your G-E Apparatus Sales Office. Take advantage of the "added value" engineering service that General Electric provides. 721-32

GENERAL ELECTRIC

✓STAINLESS BAR AND WIRE?
✓TOOL AND DIE STEELS?
✓HIGH SPEED AND MOLD STEELS?

We've got 'em in stock . . . in shapes, sizes and lengths to meet your needs

Order specialty steels from your local Universal-Cyclops Specialty Steel Service Center and gain these cost-reducing advantages:

- Fast, reliable off-the-shelf delivery from complete and expanded stocks
- Slash inventory expense and gain more productive floor space
- Deliveries tied to your production needs for greater efficiency

A leading producer of specialty steels for over 75 years, Universal-Cyclops continues to supply you with highest quality steels, expanded services and stocks, and specialized technical assistance to help solve your metalworking problems.

Call or write for your latest copy of the Universal-Cyclops Stainless Steel Stock List on Billet, Bar and Wire.

UNIVERSAL CYCLOPS
UC STEEL
STEEL CORPORATION
EXECUTIVE OFFICES: BRIDGEVILLE, PA.

STAINLESS STEELS • TOOL STEELS • HIGH TEMPERATURE METALS

STEEL SERVICE CENTER INSTITUTE

For Prompt Delivery From Stock—Call, Wire or Write—

BUFFALO	DETROIT	MILWAUKEE	ST. LOUIS
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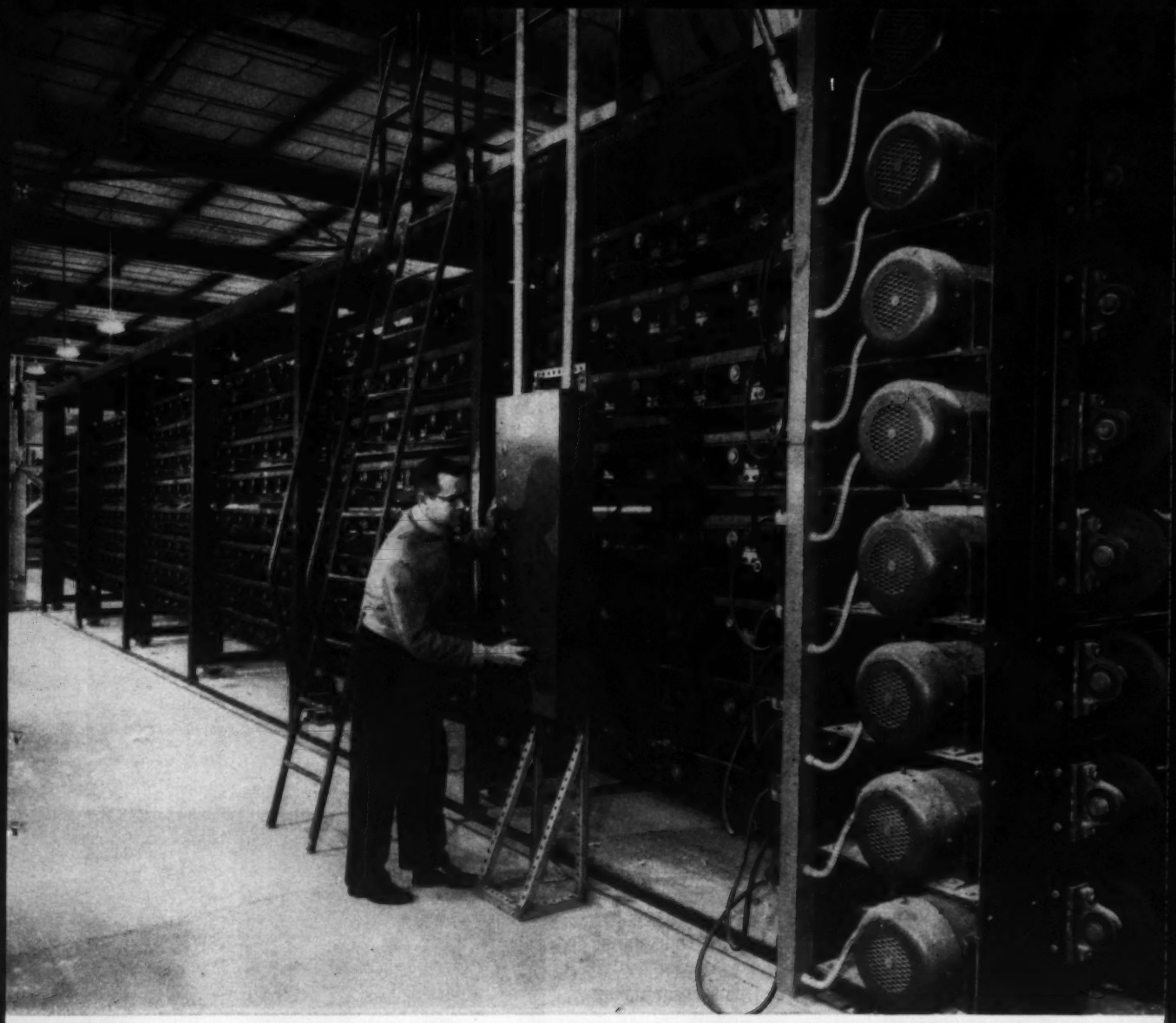
CLEVELAND	INDIANAPOLIS	PHILADELPHIA	WASHINGTON, D. C.
DAYTON	LOS ANGELES	PITTSBURGH	WORCESTER



Century motors provide continuous operation for oven conveyor

Eight Century 2-horsepower, squirrel-cage, totally-enclosed-fan-cooled motors accelerate materials onto an 8-deck feed-in conveyor at precise feed-in speeds.

At the end of this conveyor system is an oven. Materials must enter this oven at continuous speeds, and materials must be delivered to the oven constantly during each plant shift. A comparable 8-deck conveyor system is at the other end of the oven to remove the baked materials for cooling and stacking.

These eight Century motors assure the continuous flow operation pictured here. Top-quality Century motors provide the dependability required for long hours of stop-start operation.

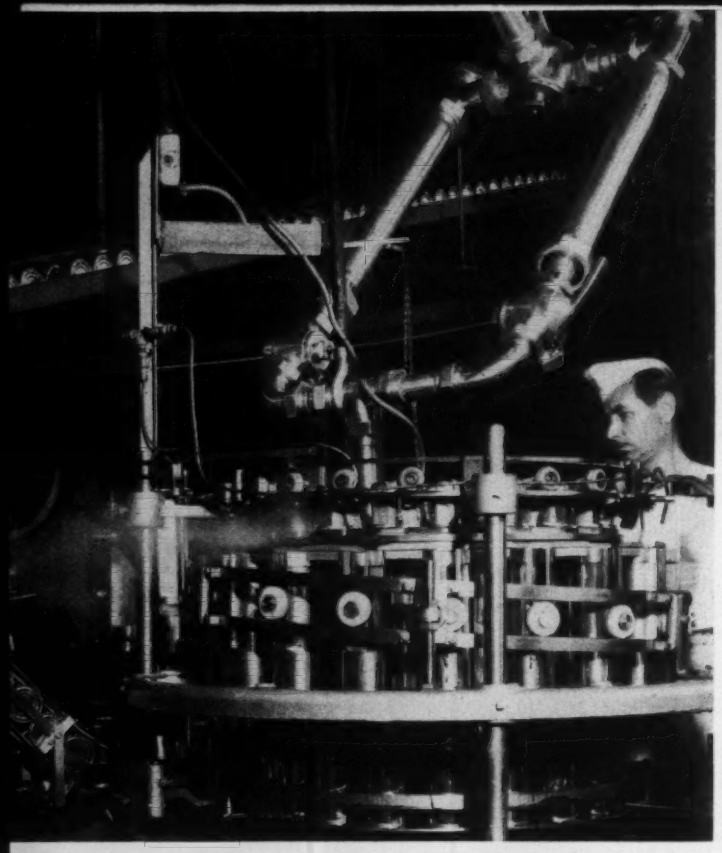
Your Century sales and application engineer, a full-time motor specialist, can help you choose the right motor for your needs from Century's full line of from 1/20 to 400-horsepower motors. Just contact him or your authorized Century motor distributor.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

60-12



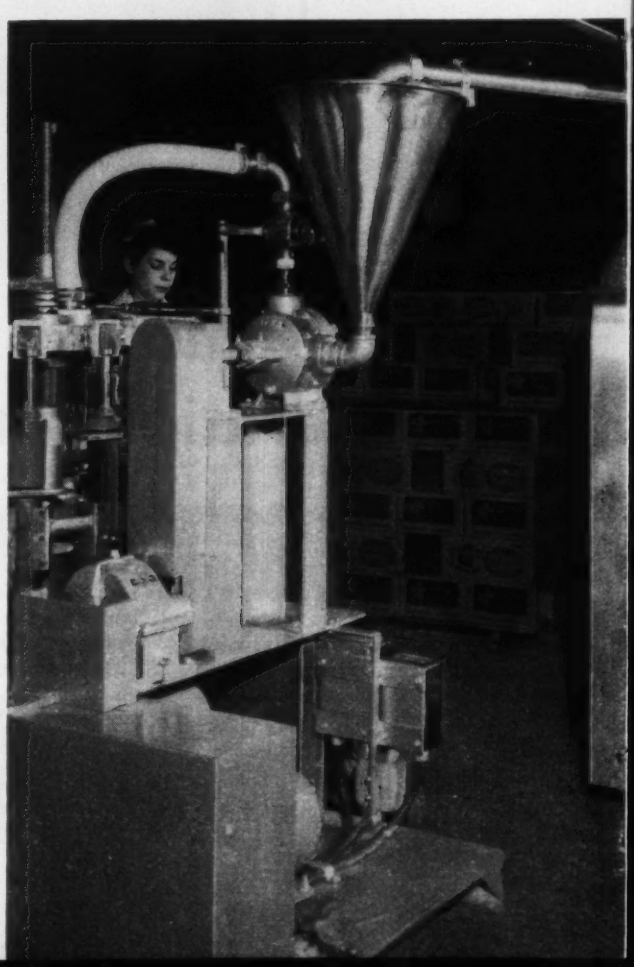
...LIQUID

If you make equipment that fills cans with chocolate or consomme, prune juice or pop, equipment made of Stainless Steel will do it fast, dependably, cleanly. The Votator* piston filler shown here happens to be filling cans with chocolate. Made of Stainless Steel, this filler can't harbor germs because Stainless Steel has a smooth, pocket-free surface. It is easily cleaned, too, so the strict standards of cleanliness that are mandatory in any food processing plant are easily maintained. Stainless Steel's resistance to corrosion makes it ideal for liquid applications.

**VOTATOR is a registered trademark of the Chemetron Corporation.*

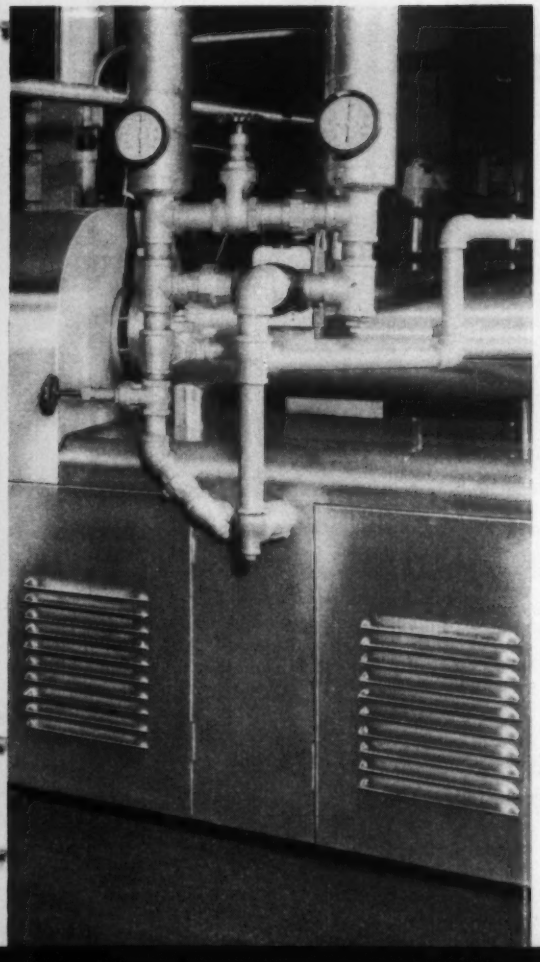
SOLID...

If you make equipment that processes solids like peanut butter or shortening, Stainless Steel can make your job easier and more profitable. This system makes peanut butter . . . and it makes it creamier. It takes whole peanuts in one end and grinds them, then Votator equipment heats them, cools them and turns out the finished product, ready for sandwich or cracker, at the other end. Here, Stainless Steel is used in the heads and shaft of the heat transfer area to assure maximum cleanliness. In a sealed unit like this one, corrosion could be a problem so Stainless Steel's inherent corrosion resistance is put to good advantage.



USS Stainless Steel . . .
no other metal makes such a material difference in so many applications

This mark tells you a product is made of modern, dependable Steel.



...and in between

No material can match Stainless Steel's versatility. Stainless Steel offers designers and fabricators a unique combination of properties: superior strength, extraordinary corrosion resistance to an enormous variety of materials, outstanding properties at high temperatures, and attractive appearance. It is easily fabricated, and because Stainless Steel lasts longer, actually costs less in the long run.

For unmatched efficiency, durability, ultimate economy, specify Stainless Steels . . . no other metal makes such a material difference in so many applications.

If you have a selection or delivery problem, ask your USS representative or nearest Steel Service Center.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
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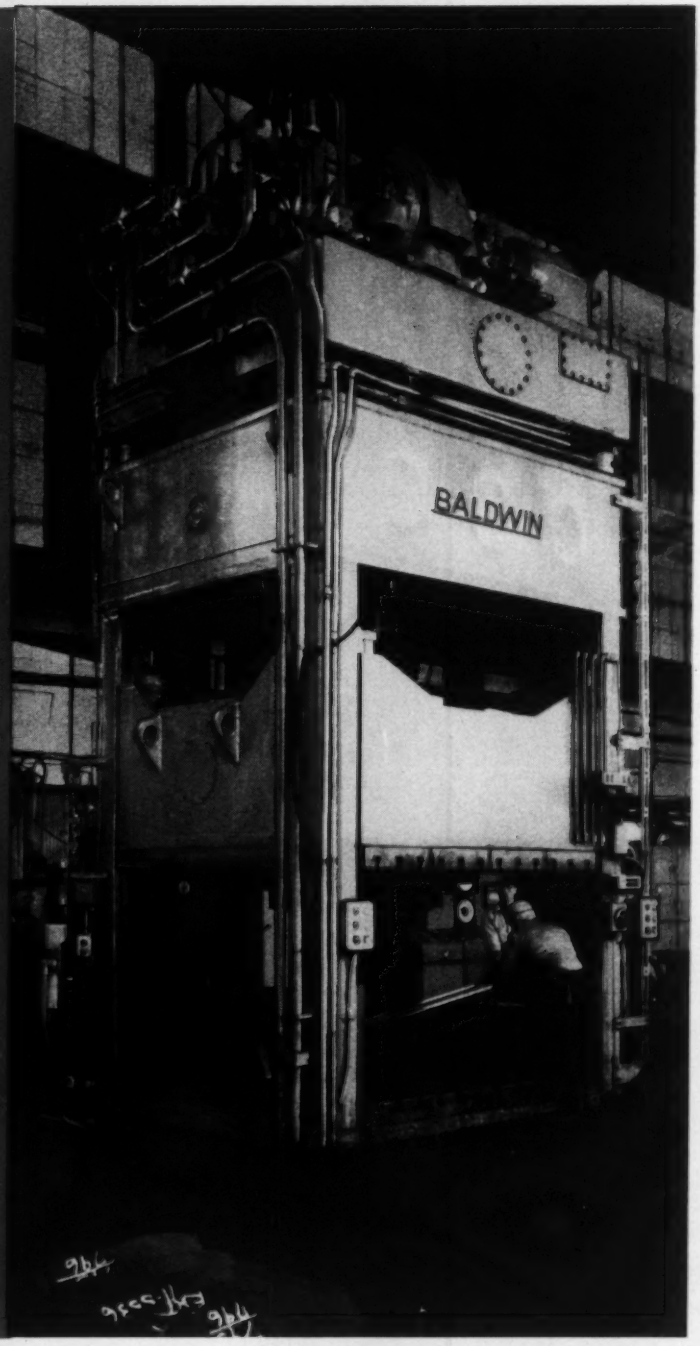
United States Steel

BALDWIN presses for high speed, versatility, accuracy... PROFITABLE PRODUCTION



Baldwin press produces various railroad car parts at high speeds in plant of American Car & Foundry Div., ACF Industries, Huntington, W. Va.

This self-contained, oil-hydraulic Baldwin metalworking press is another example of B-L-H's ability to engineer and build fine, versatile production tools. Ram capacity is 500 tons, bolster size is 120 x 102 inches. Its features can assure profitable production in your shop, too:

- All welded steel construction
- Equilibrated gibs assure precise alignment
- Adjustable cushion-ejector system
- Selector switch-controlled operating cycles
- Major hydraulic control components are "modular-mounted" for easy adjustment and maintenance.

Baldwin hydraulic presses are available in all tonnages and sizes, designed to handle any metalworking jobs—from stamping to deep drawing to heavy plate forming.

Expanded facilities at our Industrial Equipment Division assure continued high standards of manufacture. Write us for detailed information and specifications.

BALDWIN · LIMA · HAMILTON
Industrial Equipment Division · Philadelphia 42, Pa.

BALDWIN BLH LIMA-HAMILTON

"There's always room for more!" Sure, the VCA Exhibit (Booth #204) at the Metal Show in Philadelphia on October 17 to 21 will be a popular gathering place. That's one reason why you'll want to pay us a visit.

There are other good reasons for being there, too. VCA is *always* headquarters for the latest information on ferroalloy developments and applications. It is the place to go for the most complete line of quality ferroalloys . . . for experienced advice and counsel on alloying problems . . . for prompt service and highly efficient technical cooperation. As a leader in the field, with its modern research and production facilities, VCA is in fact your best source of progress and improvement in steel through ferroalloys.

We're looking forward to seeing you. Vanadium Corporation of America, 420 Lexington Avenue, New York 17, N. Y. • Chicago • Cleveland • Detroit • Pittsburgh

Steel

VANADIUM
CORPORATION OF AMERICA
Producers of alloys, metals and chemicals

VANCORAM

DOW
SOLVENTS

ANNOUNCING...

Chlorothene NU

New stabilizer system solves corrosion problems—makes recovery easy!

Newly developed Chlorothene® NU combines high solvency and safety with an advanced stabilizer system that makes possible an extraordinary range of cold-cleaning applications—makes recovery easy, too!

The exceptional stability of Chlorothene NU (specially inhibited 1,1,1-trichloroethane) practically eliminates corrosion of sensitive metals. You can use it for cleaning aluminum, zinc, and white-metal alloys—as well as other metals, many plastics, rubber products and other materials.

Because increased stability makes recovery easy and practical, you can enjoy the economy of using Chlorothene NU over and over again. In most cases, existing equipment, such as a trichloroethylene still, does an excellent job.

Safe two ways! Low in toxicity, Chlorothene NU has a maximum allowable vapor concentration of 500 parts per million. That's closely comparable to many flammable solvents and is substantially more favorable than most chlorinated solvents. In addition, Chlorothene NU has no fire or flash point, as measured by standard methods. These features not only make Chlorothene NU safer to use—they simplify new cleaning systems and waste disposal.

COLOR CODED—For easy identification, even from 100 feet away, drums of Chlorothene NU are distinctively color-coded in green and white. For more information about Chlorothene NU, call your distributor of Dow solvents. He knows all about its use, recovery and comparative cost. Or contact your nearest Dow sales office.

THE RIGHT SOLVENT FOR THOUSANDS OF INDUSTRIAL USES. Not only is Chlorothene NU recommended for cold-cleaning dip operations on the production line—it also cleans by spray, bucket or wipe methods. It's an all-purpose solvent for many applications, both on the production line and for maintenance use.

SEE YOUR DISTRIBUTOR OF DOW SOLVENTS FIRST!

The widest line of industrial solvents: Trichloroethylene, Perchloroethylene, Methylene Chloride, Chlorothene NU.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN DOW

See "The Dow Hour of Great Mysteries" on TV.

MUSIC WIRE

BY

WASHBURN

has reached even higher standards of QUALITY than ever before. Our **CADMIUM** plated Music Wire especially merits your careful investigation if you are interested in superior corrosion resistance.

Our QUALITY will satisfy you . . . Our SHIPMENTS prompt, from ample stock . . . Our INTEREST in Customer requirements means "Once a Washburn Customer Always a Washburn Customer"

WASHBURN

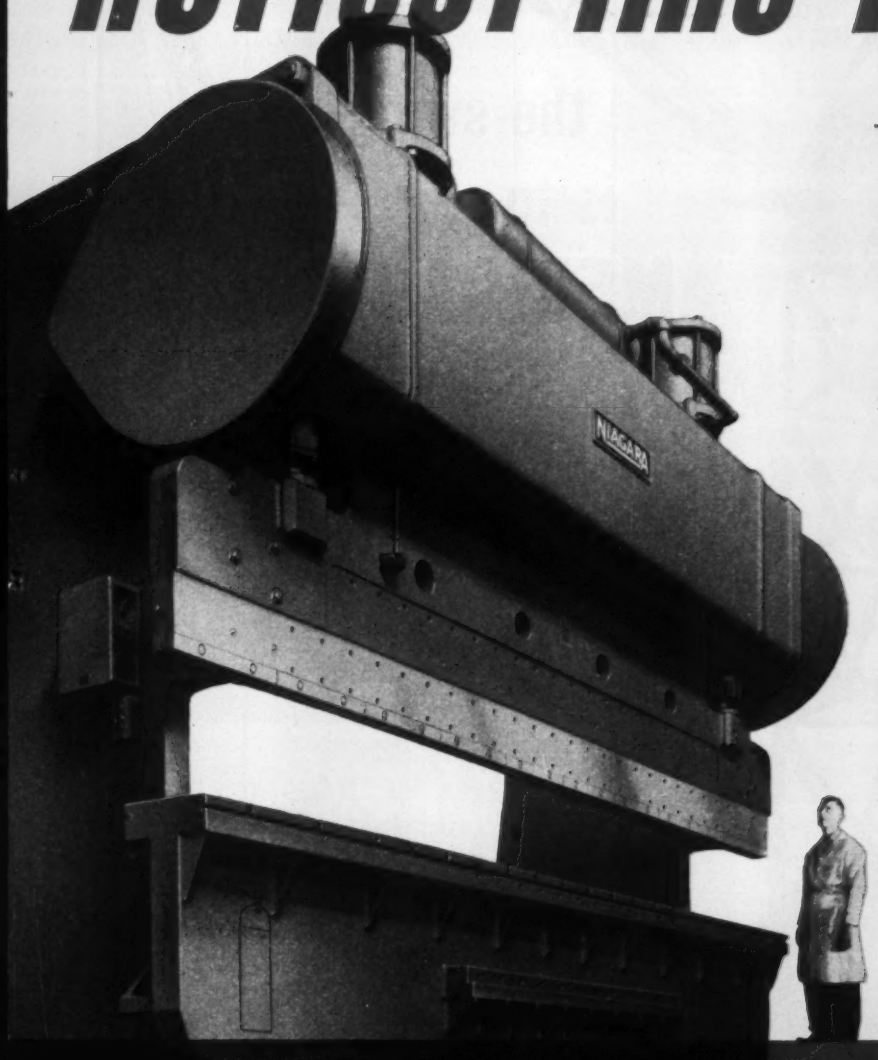
WASHBURN WIRE COMPANY, NEW YORK CITY

CLEAN, UNIFORM BILLETS-STRIP-RECTANGULAR, ROUND, FLAT RODS

TEMPERED AND UNTEMPERED FLAT AND ROUND HIGH CARBON WIRES

NIAGARA PRESS BRAKES

hottest line today



...way out front in production-boosting, cost-cutting features... highest dollar value of all

Hottest line in the industry, more Niagara Press Brakes are being bought today than ever before.

What's behind it? **Performance!** Downright, measurable, press brake performance! High hourly output with minimum operator effort is setting new work standards in plant after plant.

How about you? Want to sail through your schedules at record-breaking speed... cut your operating and maintenance costs to the bone... hold your capital investment to a **practical minimum... then Niagara is the press brake for you.**

Talk it over with a Niagara sales engineer. He has the facts to give you a fair comparison **...on every point.**

77 sizes to choose from

- 15-1500 tons
- Power or Manual Clutch
- Smooth, micro-inching ram
- Wear resistant, non-metallic ways
- Gearing enclosed in sealed oil bath

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N. Y.

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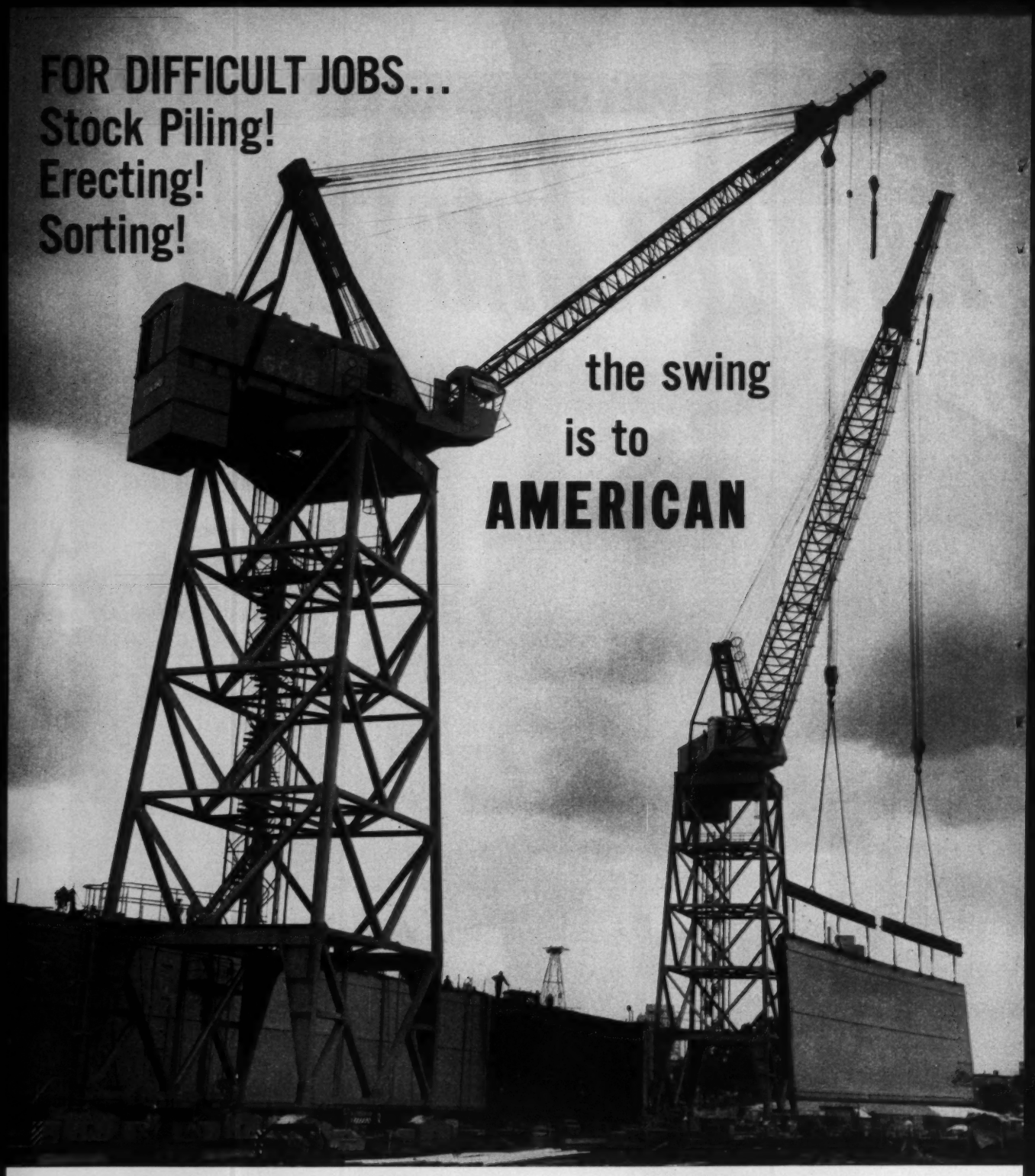
Distributors in principal U. S. cities and major foreign countries



Write For Information On American's Full Line Of Industry-Proven Revolver Cranes

AMERICAN HOIST
and Derrick Company
St. Paul 7, Minnesota

EXCAVATORS-CRANES
to 4½ yds.-110 tons
LOCOMOTIVE CRANES
to 130 tons

DERRICKS-HOISTS
to 800 tons
REVOLVER CRANES
to 400 tons

CROSBY-LAUGHLIN
DIVISION
Forged fittings
for wire rope-chain

Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

How **HEWLETT-PACKARD** marks instrument panels faster, for less with **DENISON** Multipress

MARKING

MARKING INSTRUMENT PANELS *with 50-ton (left) and 125-ton Denison hydraulic Multipresses at Hewlett-Packard Company, Palo Alto, California. Multipress saves 8 to 10 times the cost over former marking methods. Completed, typical panel is shown at left.*

MARKING instrument panels with Denison hydraulic Multipress is saving Hewlett-Packard Company 8 to 10 times the cost of previous hand engraving methods which proved too costly, too slow.

These problems were solved—and marking costs greatly reduced —with installation of two Denison hydraulic Multipresses.

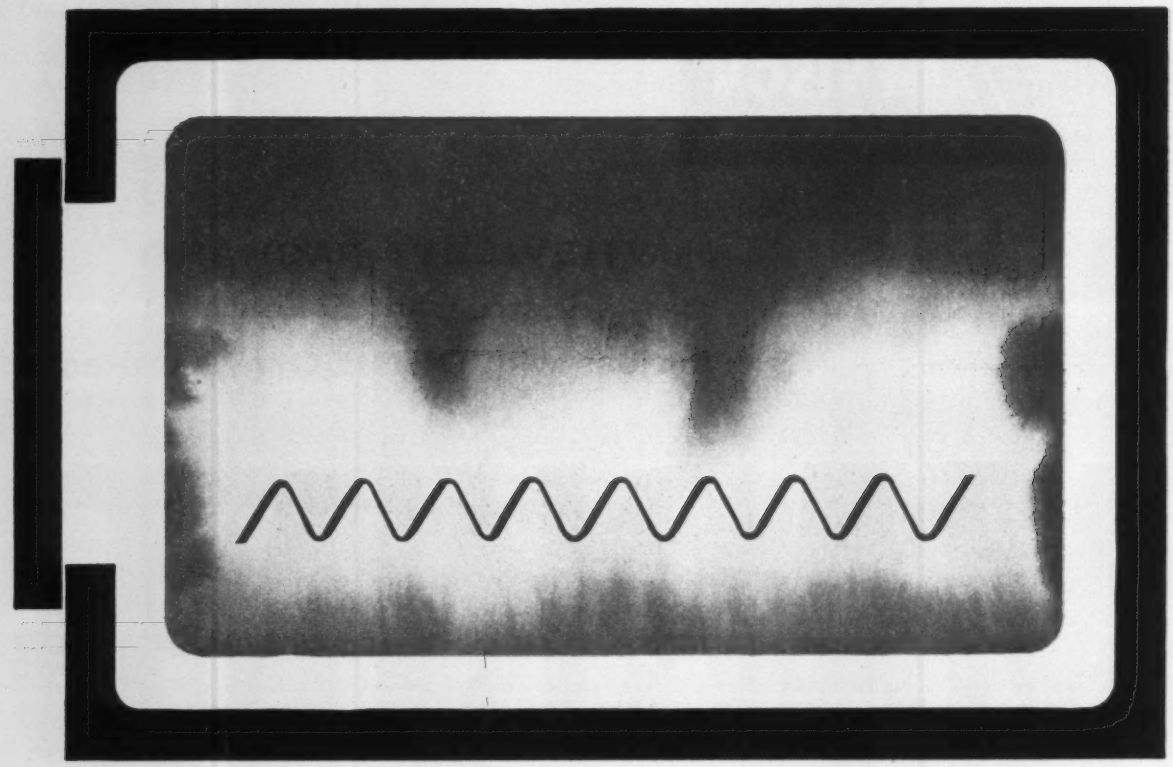
The presses are operated at pressures from as low as 50 lbs. to a maximum of 125 tons with control of stamping depth to within .001"—evidence of extreme precision *and* versatility. Hydraulic press marking also allowed use of a less expensive aluminum stock which substantially reduced raw material cost.

Hewlett-Packard's savings are typical of how Multipress can do hundreds of presswork jobs better and save you production money. Ask the Denison Production Specialist near you about a **M**ultipress **A**nalysis **P**rogram in your plant. There's no cost to you. He'll welcome working with you to **M A P** new ways to speed, improve and lower the cost of your press operations.

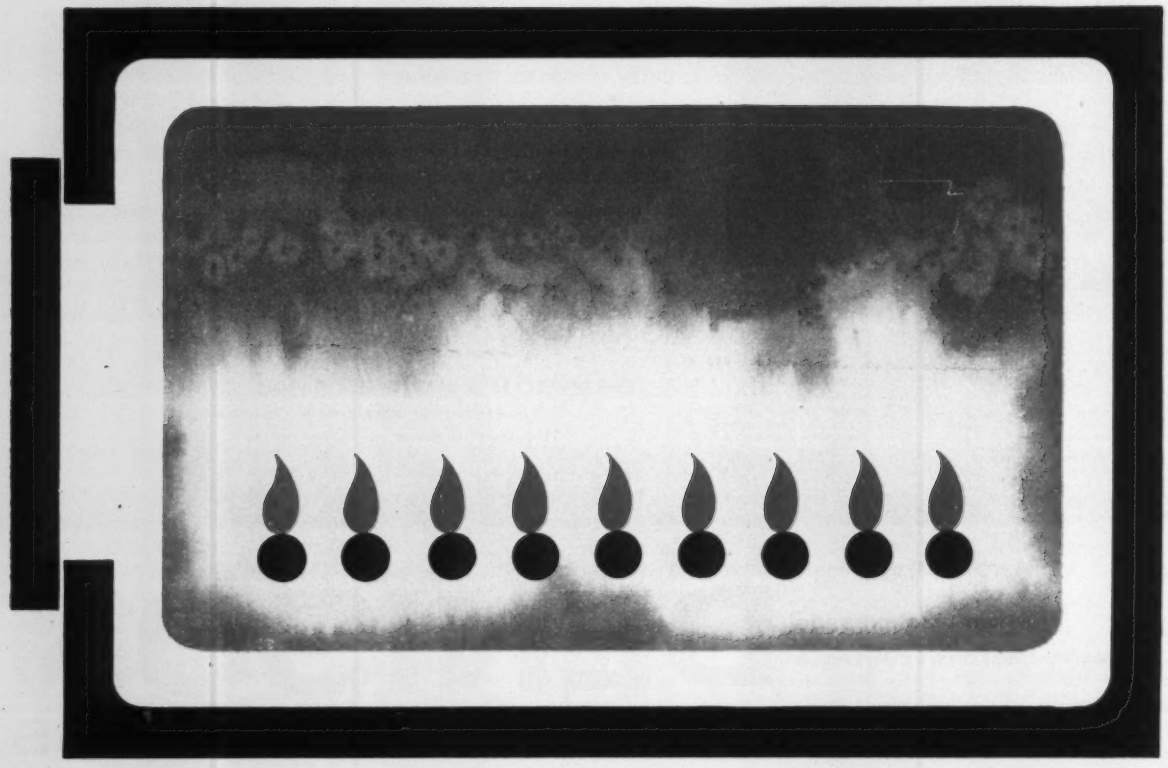
DENISON ENGINEERING DIVISION
American Brake Shoe Company
1180 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON
HYDRAULIC MULTIPRESS



Honeywell can put your



If you're planning to put a new electric or fuel-fired furnace on the line, a Honeywell control package will save you installation time and assure you of the best possible results.
(*The package consists of a complete furnace control system and all the application engineering, installation and maintenance assistance you require.*)

Honeywell makes *all* types of furnace controls, including complete saturable reactor systems, master-slave program systems and flame safeguards.

new furnace to work faster, better

Control panels and cubicles are custom-engineered, and arrive at your plant already piped and wired. Honeywell will do the whole installation or provide standby supervision, as you prefer.

After your furnace is on the line, you can rely on Honeywell for periodic maintenance to keep your controls in top condition, and for immediate service in case of emergency.
Get complete details from your nearby Honeywell field engineer. Call him today . . .
he's as near as your phone.

75th YEAR — PIONEERING THE FUTURE

Honeywell

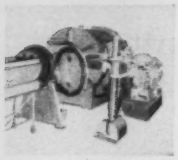
First in Control

SINCE 1885

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.
In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Lindberg's exhibit at the ASM Show will have something of interest to anyone concerned with the application of heat to industry

Whatever your interest in industrial heating processes or equipment, we've carefully assembled material for our ASM Show exhibit to make sure that there will be something interesting enough to make your visit well worth while. Since Lindberg covers the entire field of "heat for industry" you can count on our coming up with helpfully informative ideas on all angles of this important phase of industry. If you are an old friend of ours we'll be happy to welcome you again. If you don't know all about Lindberg please come in and get acquainted. Here is a preview of some of the things we will be able to show and explain when you drop in:



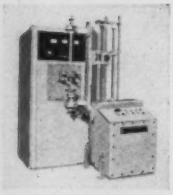
VACUUM HEAT TREATING FURNANCE

For example, you'll get information on vacuum heat treating, a complete picture of all types of vacuum heat treating furnaces and the advantages and specific uses of each. We know you'll be glad to be fully informed on this important method of metal treatment.

You will also be able to see and hear about the interesting developments we are making in the application of the new radiant wall heating principle to industrial heating equipment.

You will be interested, too, in a new development in Lindberg-Upton Salt Bath Furnaces. We call this the Cross-Channel Furnace, an entirely new concept of salt bath heating. This new type furnace provides a number of advantages: bottom heating; better salt circulation; inexpensive replaceable electrodes; long liner life; higher voltages; lowest salt absorption.

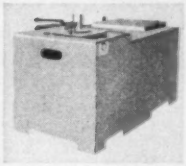
CROSS-CHANNEL SALT BATH FURNACE



HIGH FREQUENCY UNIT AND ZONE SCANNER

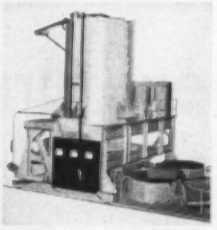
If you have not been aware of the developments Lindberg is making in equipment for the important semiconductor field, we will be able to bring you up to date at the exhibit. We will have there our newly developed horizontal zone refiner for purifying metallic germanium and full information on all our zone scanning equipment. You can learn about our gaseous and solid diffusion furnaces for basic research, pilot plant work or production of solid state devices. On display we'll also have a new conveyor type pilot plant furnace, ideal for small production heat treatment of metals and for alloying transistors and magnetic metals for the electronic industry.

One of the most interesting developments we will have on display at the show is a new idea in two-chamber induction aluminum melting and holding furnaces. This features a removable inductor section which will drastically reduce furnace down time when channel replacement is required. With this new development maintenance costs are also satisfyingly minimized as the need for complete furnace relining is greatly reduced.



TWO-CHAMBER MELTING AND HOLDING FURNACE

Possibly you are not familiar with the remarkable progress Lindberg Industrial Division has made in field erected installations. We will be pleased to show you many important complete installations of all types of industrial heating equipment and facilities where design, engineering and construction have all been handled entirely by Lindberg. Lindberg Industrial projects have covered all phases of plant design and construction, complete plants, production lines, integrated and automated equipment.



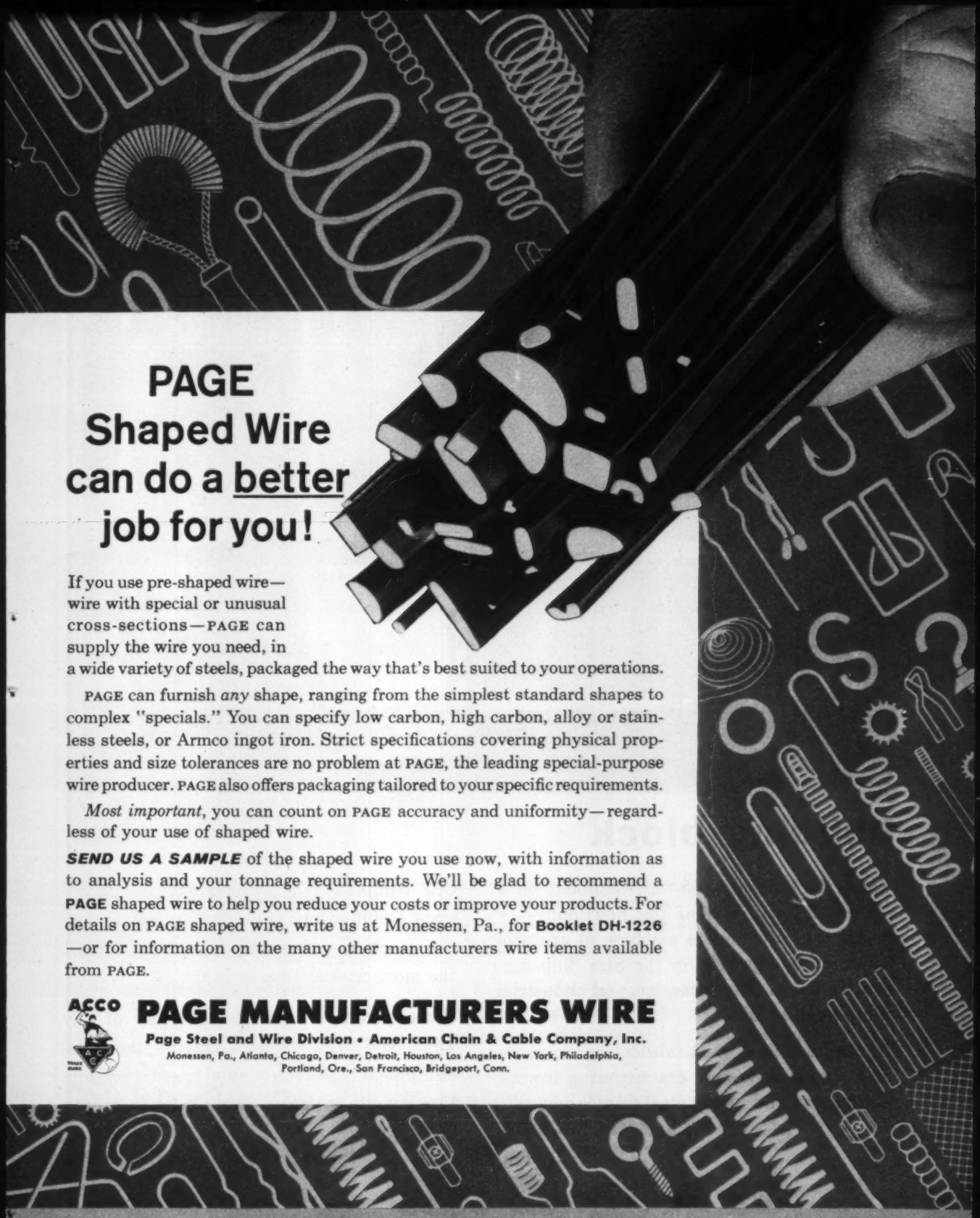
FIELD-INSTALLED GANTRY TYPE FURNACE AND FACILITIES

Anticipating your visit we will have a full representation of our top engineers and technicians on hand so you will be able to get full information on all of our new developments and also have an opportunity to discuss any of your specific problems with some of our experts. Please remember, too, that if you aren't able to see us at the show, you can always get help from Lindberg for your industrial heating requirements by getting in touch with your local Lindberg Field Representative (see your classified phone book) or by writing us direct. Lindberg Engineering Company, 2441 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, South Africa, Spain, Switzerland and West Germany.

P.S. We almost forgot this important fact: You will find Lindberg at Booth 624 in the Convention Exhibition Hall.

LINDBERG
heat for industry



PAGE Shaped Wire can do a better job for you!

If you use pre-shaped wire—wire with special or unusual cross-sections—PAGE can supply the wire you need, in a wide variety of steels, packaged the way that's best suited to your operations.

PAGE can furnish *any* shape, ranging from the simplest standard shapes to complex "specials." You can specify low carbon, high carbon, alloy or stainless steels, or Armco ingot iron. Strict specifications covering physical properties and size tolerances are no problem at PAGE, the leading special-purpose wire producer. PAGE also offers packaging tailored to your specific requirements.

Most important, you can count on PAGE accuracy and uniformity—regardless of your use of shaped wire.

SEND US A SAMPLE of the shaped wire you use now, with information as to analysis and your tonnage requirements. We'll be glad to recommend a **PAGE** shaped wire to help you reduce your costs or improve your products. For details on PAGE shaped wire, write us at Monessen, Pa., for **Booklet DH-1226**—or for information on the many other manufacturers wire items available from PAGE.

ACCO

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Page Steel and Wire Division • American Chain & Cable Company, Inc.

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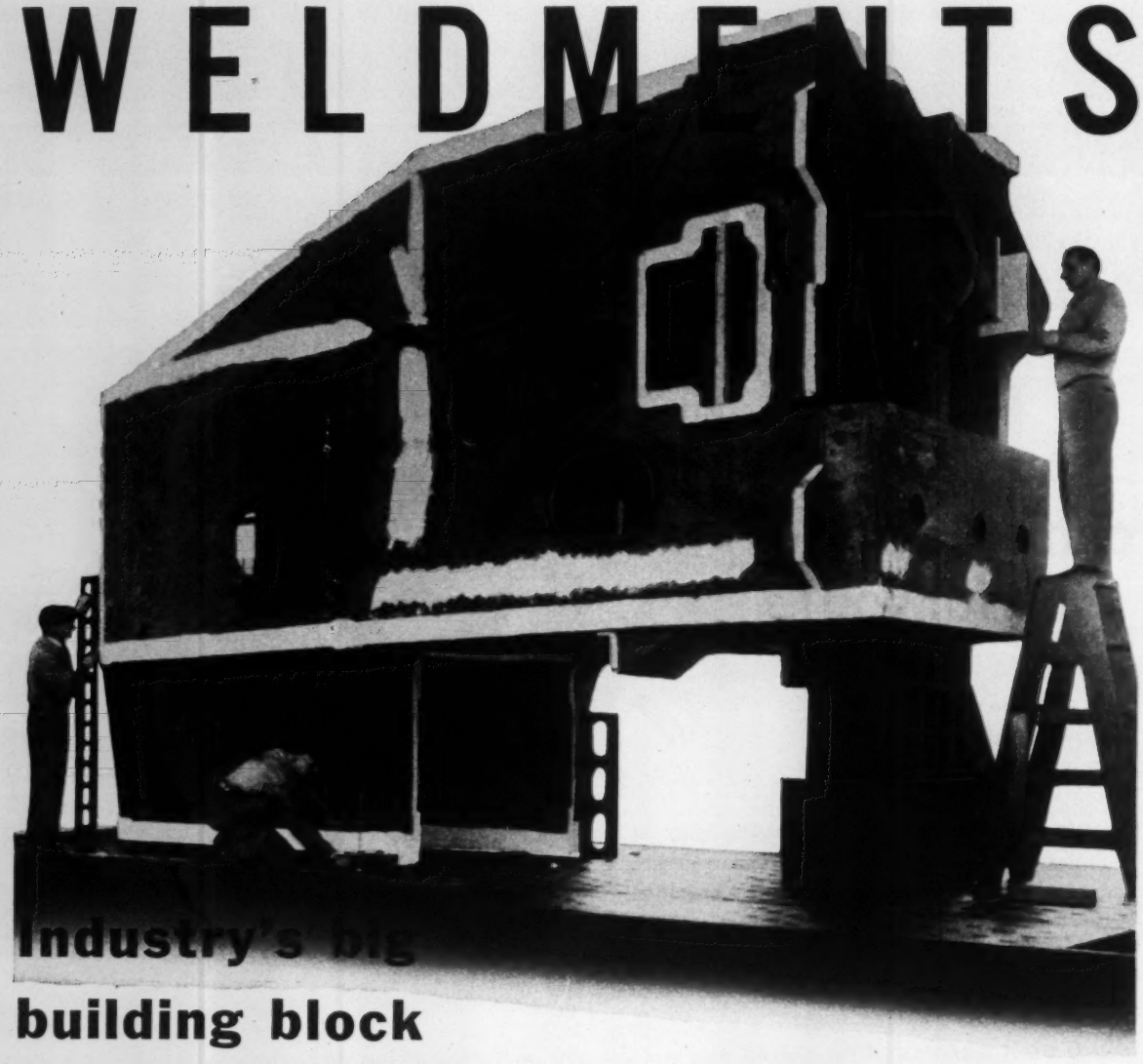
PAGE *—the source for answers to wire problems*

WELDMENTS



Industry's big building block

You're looking at a 55-ton weldment on a planer. It is typical of the machining—or building of a complete machine of any size—produced regularly in the Sun Ship machinery plant where marine and industrial equipment is built.

In our tank and steel fabricating shop, we build pressure vessels, fractionating towers, weldments, and heavy steel fabrications.

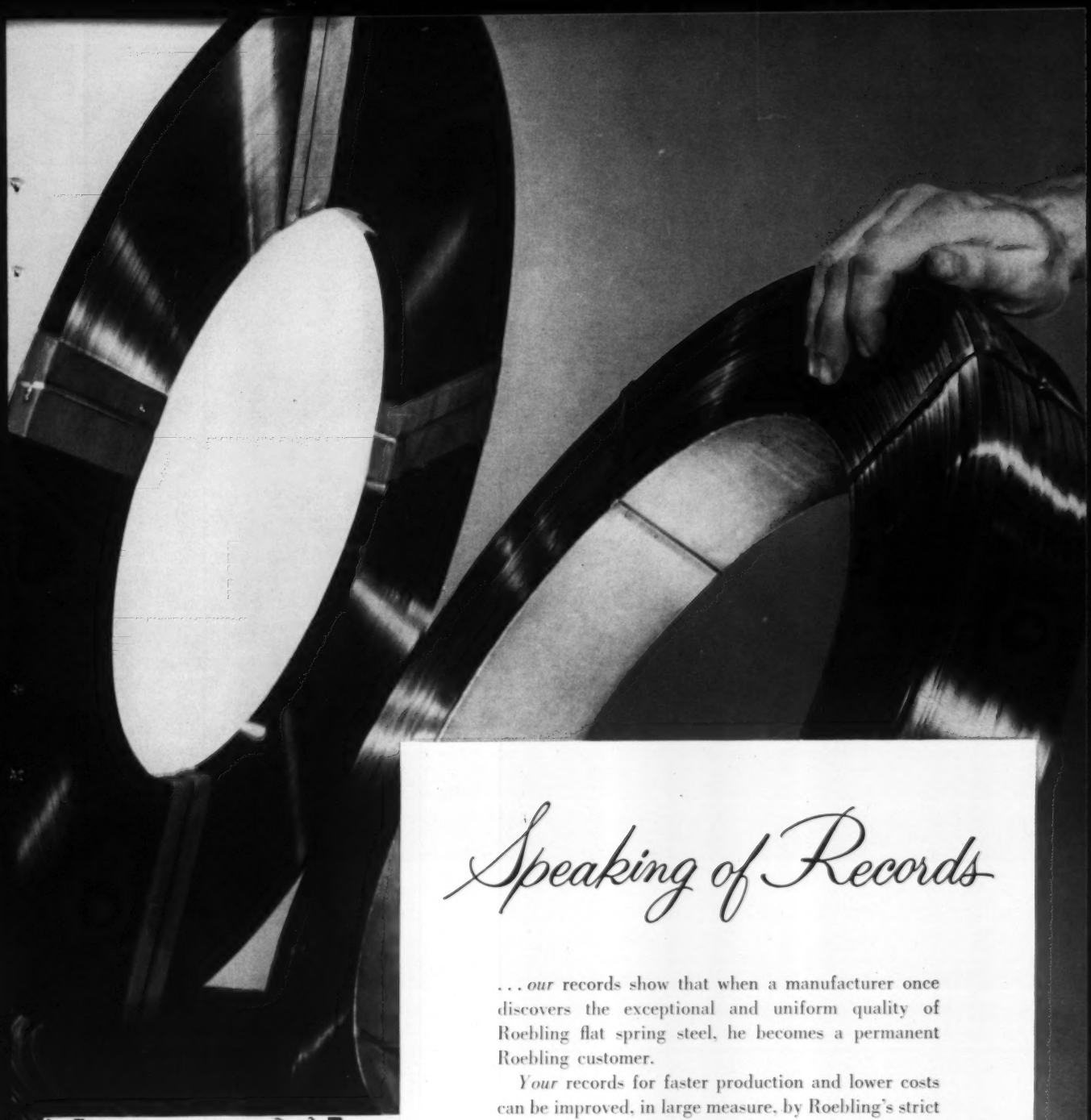
Our completely integrated shops concentrate facilities and skills for producing special machinery and components that meet the most critical standards.

When you need special machinery of any kind, you will want to discuss methods, equipment requirements and possible production layouts with Sun Ship's sales engineers.

Sun

SHIPBUILDING & DRY DOCK COMPANY

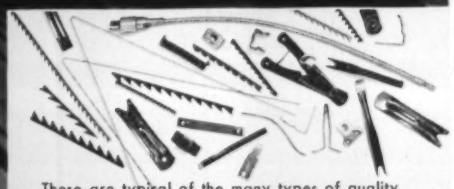
ON THE DELAWARE • SINCE 1916 • CHESTER, PA.



Speaking of Records

. . . *our* records show that when a manufacturer once discovers the exceptional and uniform quality of Roebling flat spring steel, he becomes a permanent Roebling customer.

Your records for faster production and lower costs can be improved, in large measure, by Roebling's strict attention to supplying you with the finest flat spring steel available. When you need flat spring steel, specify Roebling. Write Roebling's, Wire and Cold Rolled Steel Products Division, Trenton 2, New Jersey, for complete details.

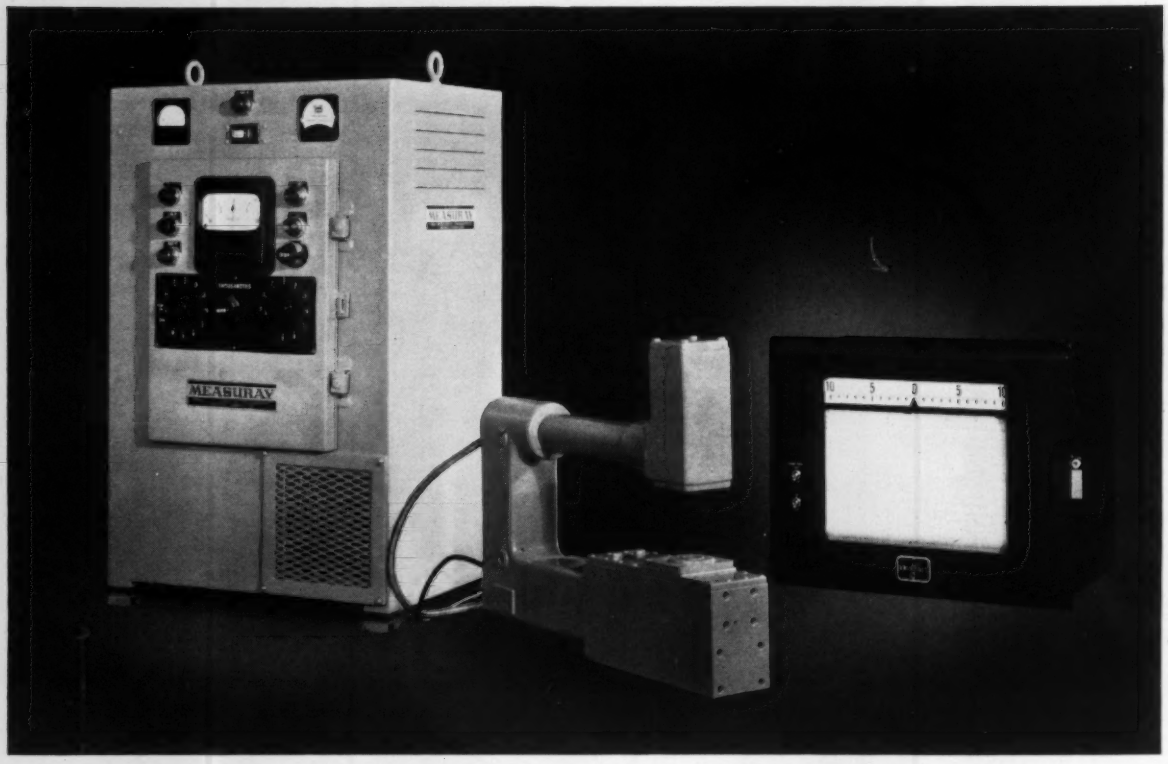


These are typical of the many types of quality parts produced from Roebling flat spring steel.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation

Roebling . . . Your Product is Better for it



New Micro-Sec Pulse circuit speeds up X-ray thickness checking with MEASURAY® gages

Increased speed of response up to 50 times faster than conventional X-ray gages and beta ray gages, is made possible by Sheffield's new Micro-Sec Pulse circuit.

Also, this permits focusing the beam as narrow as .040" wide. For the first time, striations or grooves as close together as 1/16", can be defined in foil, plastic sheet or film, without sacrifice of speed of response. Changes in the thickness of material being gaged are detected instantly and the amount read with great accuracy.

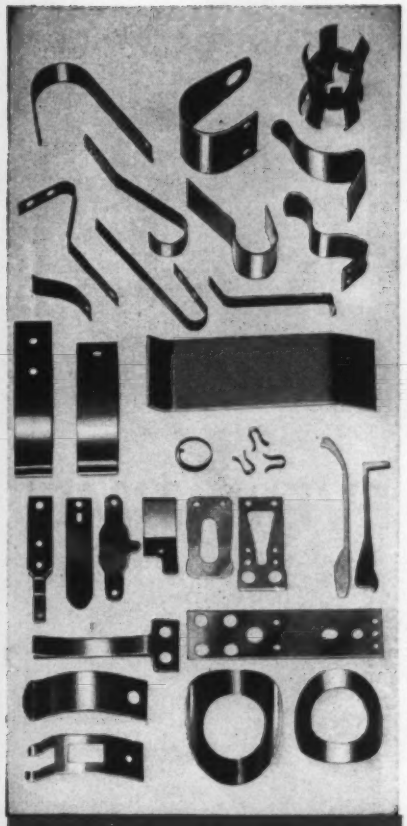
Measuray non-contact gaging enables you to measure materials in motion, up to very high temperatures, without touching. Ferrous and non-ferrous hot and cold rolling mills; producers of plastic sheet and film, foil, and paper are using Measuray non-contact X-ray gages to keep their costs competitive.

An operating Measuray can be set up in your plant to demonstrate what it can do for you—without obligation. Write, wire or phone Measuray Department.

The
SHEFFIELD
Corporation *Dayton 1, Ohio*

A subsidiary of The Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.



SANDVIK

SPRING STEEL QUALITY

Earns Its Pay By PRECISE PERFORMANCE

Where performance is important, Sandvik spring steel quality is well worth its price. Many spring steel users have found that Sandvik delivers the *exact* performance they want under their tools and in their products.

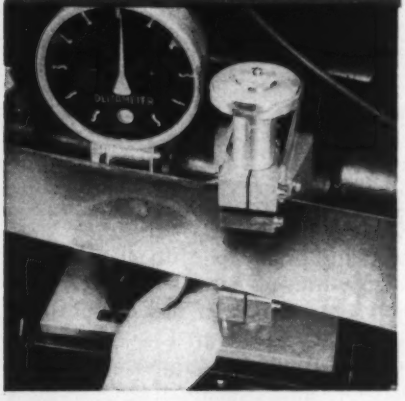
Sandvik's purity, small lot processing and painstaking quality control assures your money's worth in consistent quality performance.

In addition to the wide variety of qualities and sizes carried in stock, Sandvik has local facilities for custom-processing and finishing to your requirements.

For specific physical properties plus accurate flatness, straightness, width, gauge and edge finish, specify a Sandvik spring steel.

Send for free brochure on various Sandvik cold rolled and hardened and tempered strip steels.

Strip thickness is checked during rolling and at final inspection with a "Deltameter", an instrument developed at Sandviken for measuring variations of thousandths of a millimetre.



SANDVIK STEEL, INC.

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88-200

POSITIVE DUPLICATION – EVERY TIME!

These highly accurate apothecary weights give *exact* results, time after time after time. You will get this same kind of Positive Duplication with these center-type grinding wheels, and with *all* CINCINNATI (PD)° GRINDING WHEELS.

HOW POSITIVE DUPLICATION IS ACHIEVED

The predictable performance of these wheels is the positive result of Cincinnati's unique (PD) manufacturing process. It involves 36 separate quality controls which produce grinding wheels of unsurpassed uniformity. For example, sensitive print-weigh scales put an unmistakable record on each mix card of the exact amounts of materials used. And the figures *must* correspond to the exact amounts called for.

UNIFORMITY HELPS YOU

When you use CINCINNATI (PD) WHEELS you can plan production schedules with the assurance that each reorder wheel will act and grind exactly like the original. This is the promise—and *performance*—of Positive Duplication.

CALL CINCINNATI TODAY

Solve your grinding problems with the help of Cincinnati's factory-trained specialists. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI (PD) GRINDING WHEEL Distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

(PD) POSITIVE DUPLICATION

CINCINNATI° GRINDING WHEELS

°Trade Mark Reg. U. S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

NORTHERN Cranes for scrap yard handling

These magnet handling, heavy duty Northern yard cranes handle scrap continuously in many scrap yards, foundries, steel mills and industrial plants.

NORTHERN CRANES — in this and many similar installations — assure: (1) higher operating speeds for faster turnover of salvage materials as related to yard space; (2) dependable, continuous operation with minimum service and maintenance because of heaviest duty type fittings and equipment; (3) safer, more effective crane operation because of better visibility from Northern's Clear Vision Control Cab; and (4) lower cost operation because oil bath lubrication minimizes crane idle time and wear in load bearing parts.

This 15-ton, 80-foot span, magnet handling crane has A.C., full magnetic, counter torque lowering with motor generator set mounted on crane footwalk.

MATERIAL HANDLING EQUIPMENT BY NORTHERN

Sales representatives in all principal cities.

NORTHERN ENGINEERING WORKS
210 CHENE ST., DETROIT 7, MICH.

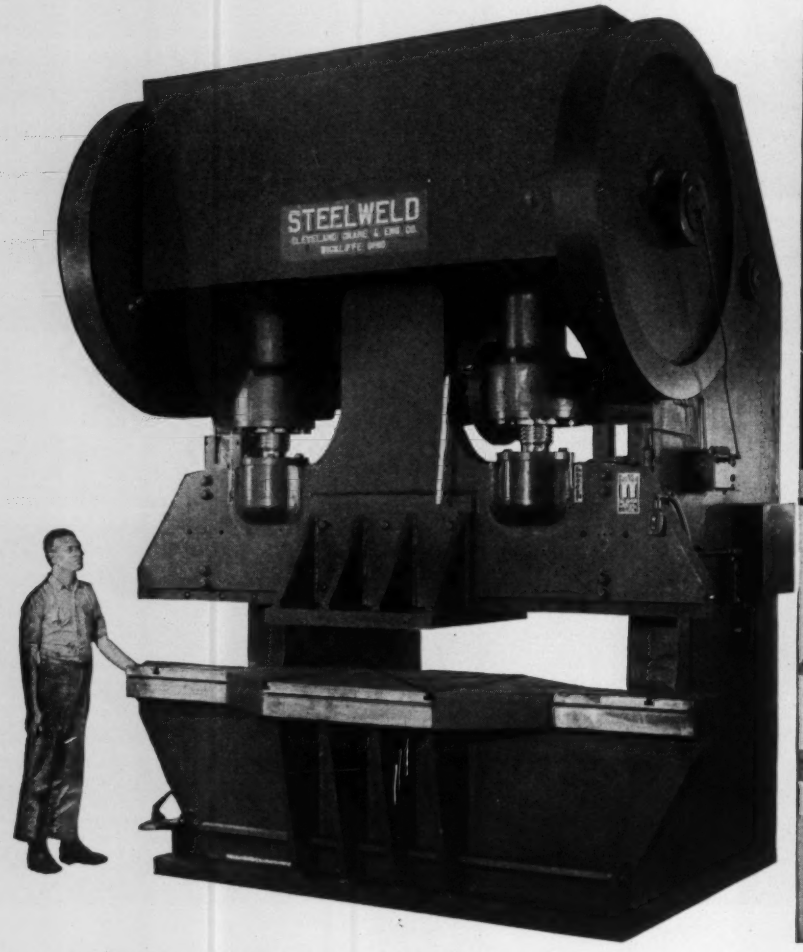
SE-2021

look overhead . . . see "NORTHERN"

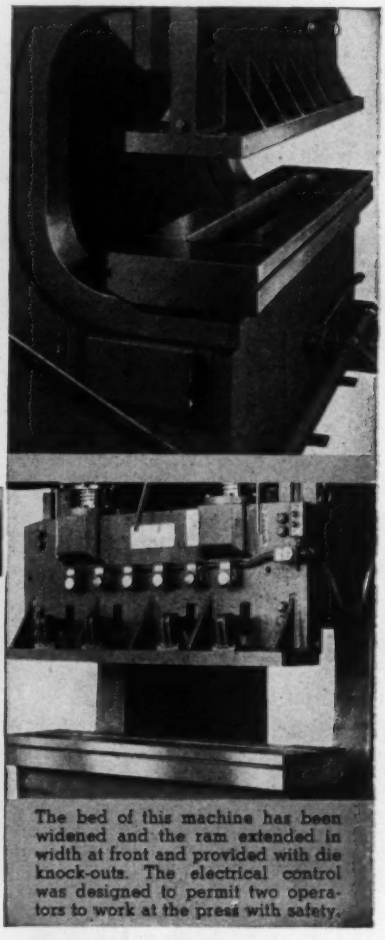
STEELWELD BRAKE DESIGN

Easily Adaptable For Special Requirements

Widening the bed of this 400 ton brake made it possible to serve a special purpose. The corresponding area of the ram was provided with a detachable ram bolster. With the bolster removed, normal brake operations can be carried on.



This Steelweld Brake was built with a double-plate bed having wide top and slot for punching purposes. This makes a low-cost press that is excellent within certain limits.



The bed of this machine has been widened and the ram extended in width at front and provided with die knock-outs. The electrical control was designed to permit two operators to work at the press with safety.

WHILE a standard press brake can handle a wide variety of metal-forming operations, often certain construction changes can be made that will permit doing work that normally would require a large costly forming press. Design changes can also be made that will speed production, improve safety or bring about other desirable advantages for specific types of work.

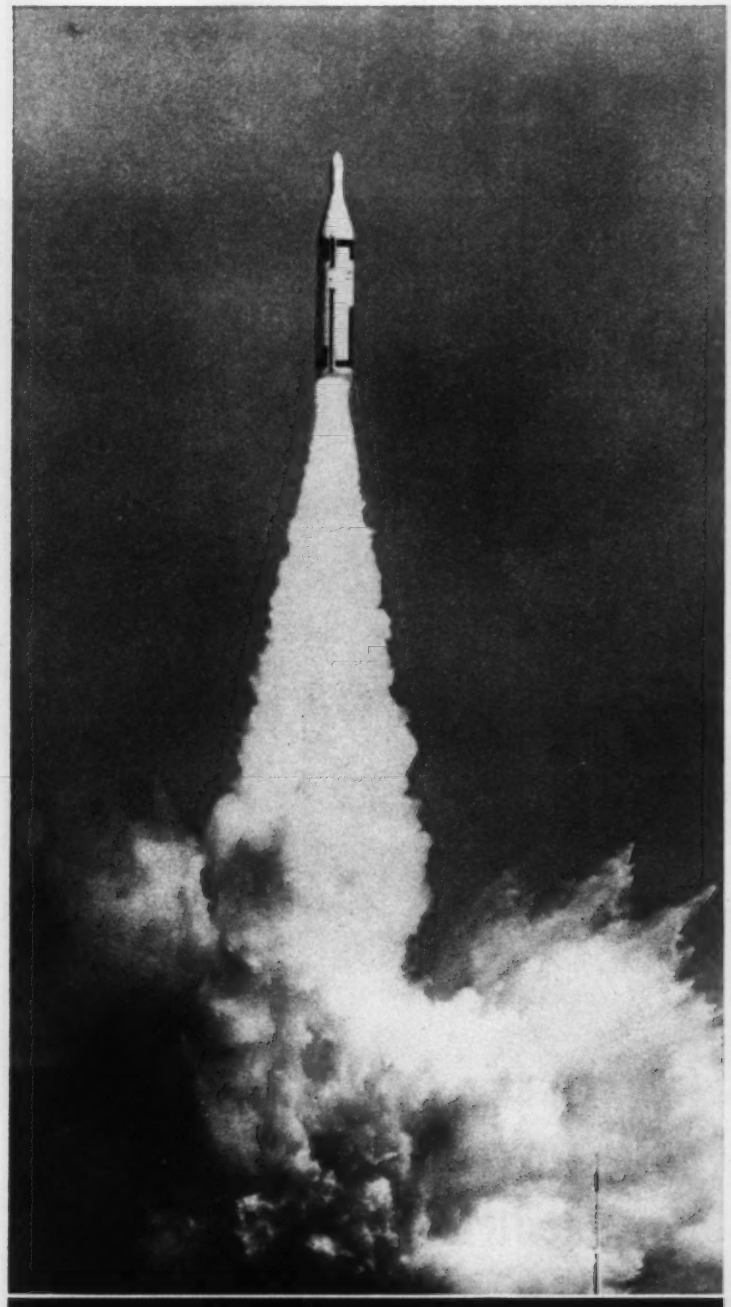
STEELWELD
PRESS BRAKES

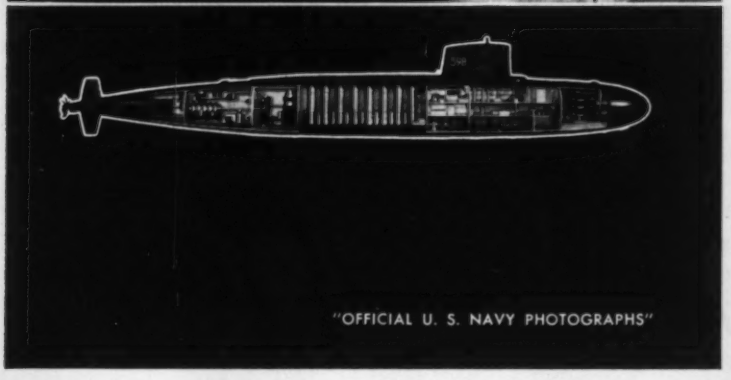
Steelweld engineers have had a great deal of experience in tailoring press brakes to suit special jobs. Brakes have been built with many types of beds, with various shut heights, different speeds, unusual control arrangements, special gauges and safety devices, unique feeding equipment, etc. Because Steelweld's design is such as to make changes comparatively easy, the cost is reasonable.

For that next metal-forming job, whether it be a standard press brake operation or an out-of-the-ordinary one, it will pay you to investigate the possibilities of versatile Steelweld Press Brakes.

Write for free copy of Catalog No. 2010

STEELWELD DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. 7865 E. 281 ST. • WICKLIFFE, OHIO





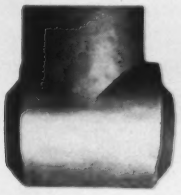
"OFFICIAL U. S. NAVY PHOTOGRAPHS"

CAMERON HELPS PUSH POLARIS

Nozzles and structural members for Polaris and a number of other important U. S. Missiles are forged by Cameron from molybdenum, titanium, tantalum-tungsten and other exotic metals.

Cameron forged stainless steel check and gate valve bodies are a vital part of the nuclear power plant in submarines of the type which fire Polaris.

Our unique forging processes, which make us a significant supplier of these critical Polaris forgings, afford many distinct advantages in the production of these and many other vital components of the national defense program.



Check Valve for the Hot Loop of Nuclear Propulsion System. These are the largest closed die stainless steel forgings ever produced.

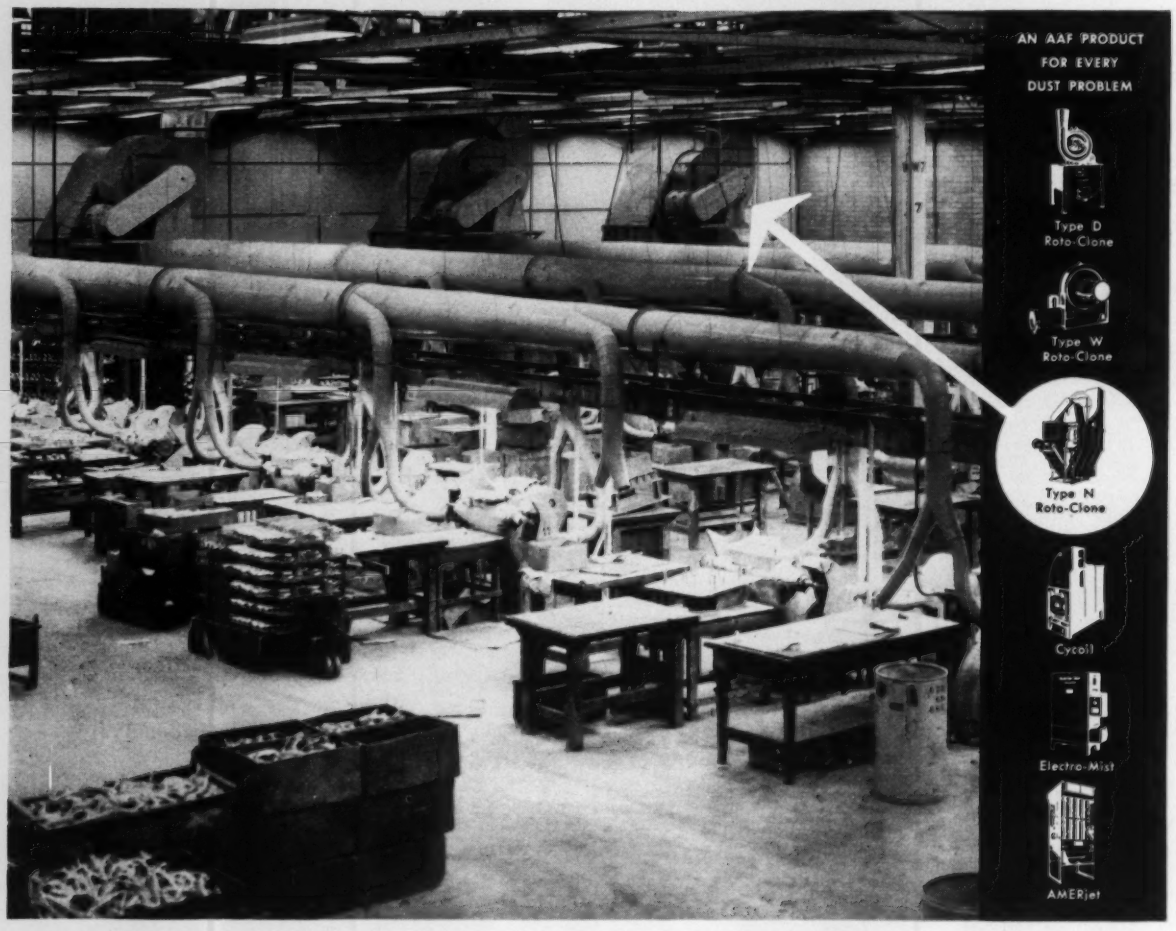
A first stage Polaris Nozzle Liner forged from pure molybdenum.

Cameron

IRON WORKS, INC.

SPECIAL PRODUCTS DIVISION
P. O. Box 1212, Houston 1, Texas

BUFFING



AAF Type N ROTO-CLONES stop dust for Electric Auto-Lite

● This sparkling clean buffing area in Electric Auto-Lite's Lockland, Ohio, plant is visible proof of the effectiveness of AAF's Type N ROTO-CLONE. These rugged wet collectors are exhausting 80,000 cfm from manual buffing of die-cast auto accessory parts.

AAF's complete line of dust control equipment was application-developed, now challenges *any* metalworking dust problem. Where are dust, fumes or mists causing you trouble – grinding, buffing, polishing, dry machining, wet machining, heat treating, abrasive cleaning? All can be effectively and economically controlled by AAF.

If buffing dust is your problem, call your local AAF representative, or write direct for Type N ROTO-CLONE Bulletin 277. Address Mr. Robert Moore, American Air Filter Company, Inc., 443 Central Avenue, Louisville, Kentucky.

AAF American Air Filter

BETTER AIR IS OUR BUSINESS

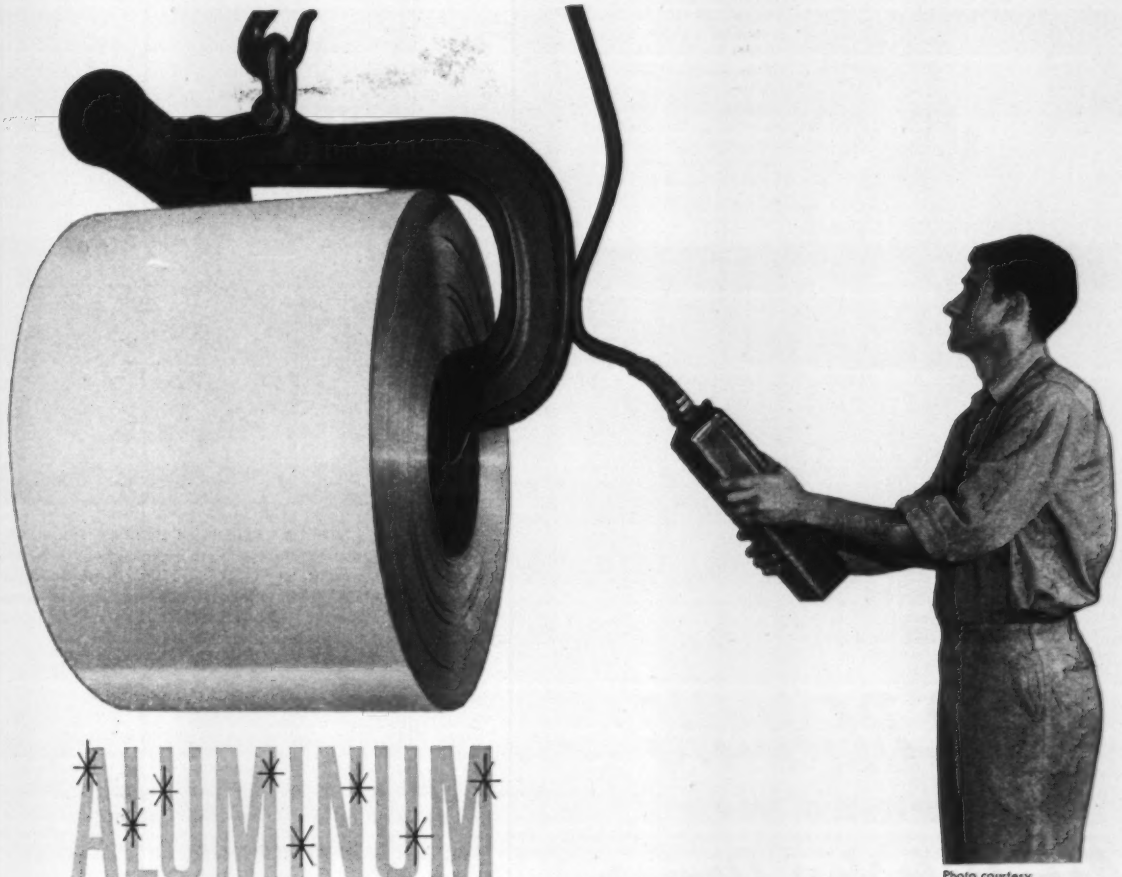


Photo courtesy
LITHO-STRIP CORP.

ALUMINUM

Bonderized and painted coil...

a revolution in product quality and performance

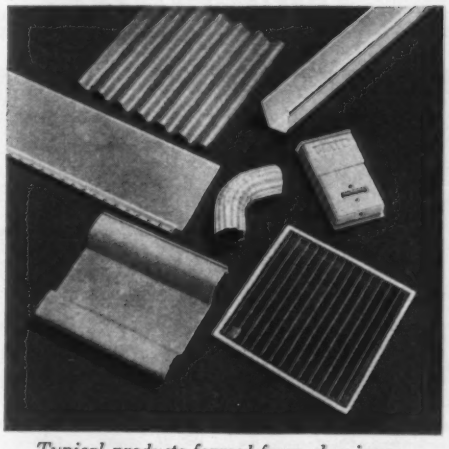
Bare aluminum enters the finishing installation and is cleaned, Bonderized and roll coat painted in continuous automated operation. Re-coiled, it's ready for forming into any one of dozens of products.

This is the most efficient, effective and economical method for painting aluminum. Straight-line production is utilized, labor and material costs are reduced, quality is maintained and the performance of the finish is spectacularly increased.

Paint adhesion over the Bonderite coating is so strong that it permits the most severe forming operations without peeling or failure.

Service life of paint over Bonderized aluminum—5 to 10 times that on untreated aluminum—assures product performance and customer satisfaction.

Aluminum, Bonderized and painted in the strip, is being used in huge tonnages today. Better investigate its economy and advantages for your production. Call in the Parker representative now!



Typical products formed from aluminum, Bonderized and painted in the strip.

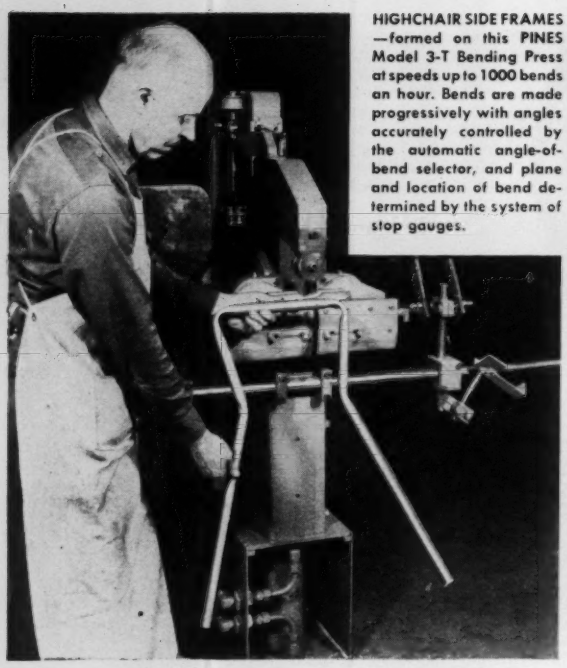
Parker Rust Proof Company
2158 E. MILWAUKEE, DETROIT 11, MICHIGAN

BONDERITE corrosion resistant paint base • BONDERITE and BONDERLUBE aids in cold forming of metals • PARCO COMPOUND rust resistant • PARCO LUBRITE—wear resistant for friction surfaces • TROPICAL—heavy duty maintenance paints since 1883

Since 1914—Leader in the field

*Bonderite, Bonderized, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.

PROTECTED BY Bonderite A PARKER RUST PROOF CO. QUALITY CORROSION RESISTANT



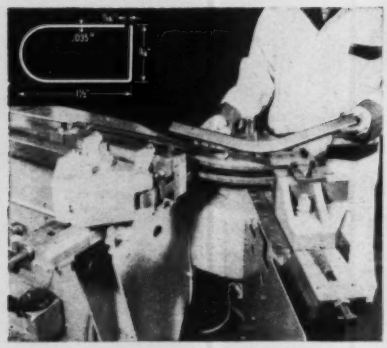
HIGHCHAIR SIDE FRAMES—formed on this PINES Model 3-T Bending Press at speeds up to 1000 bends an hour. Bends are made progressively with angles accurately controlled by the automatic angle-of-bend selector, and plane and location of bend determined by the system of stop gauges.

A DIFFICULT ALUMINUM EXTRUSION BEND—Preventing distortion and warping was difficult in making this 90° bend in 6063-T6 aluminum on a 9 3/16" inside radius. A split-type bending die and link mandrel, on a Model 2 machine, produced wrinkle-free bends with no distortion.

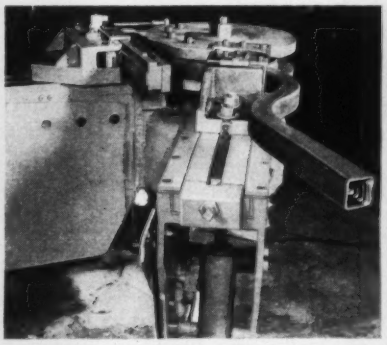
COLD BENDING
THE PINES WAY
Can Help You Remain Competitive

• High-quality bends at high speed is the key to a favorable competitive position in the fabrication of extrusions, tubing, pipe, or rolled sections. And the PINES WAY of bending is the key to quality and speed. It includes superior design, tooling to suit the job, provisions for quick setup, and competent service.

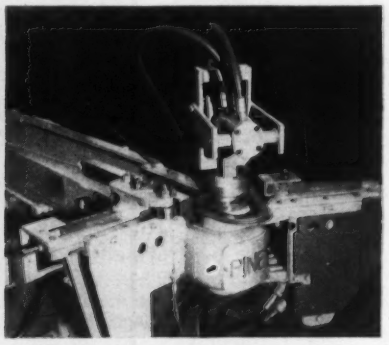
Some examples of the results of these factors are illustrated here. Whatever your metal-forming needs may be, it will pay you to investigate bending the PINES WAY. For assistance on your jobs or a cost analysis, call on Pines without obligation.



D-SHAPED STEEL CHANNEL—Unique tooling permits edge-bending without closing the 1⅛" slot. 37° bends are made on a 9" inside radius to form side rails for playground slides. Done on a Model 1¼ Bender.



SQUARE-TUBE VEHICLE FRAMES—Bending of SAE 4140 steel tubing, 3" square x .239" wall on 10½" radius is done on this Model 4 Bender. Tooling illustrates use of compound die for clamping on bent section.



FLAT STEEL BARS—Three ¾" x 1" bars are bent in one operation to 160° on this Model 1 Bender. A split die actuator opens the dies for easy removal of the pieces. Bends are smooth and wrinkle-free.

PINES ENGINEERING CO., INC.

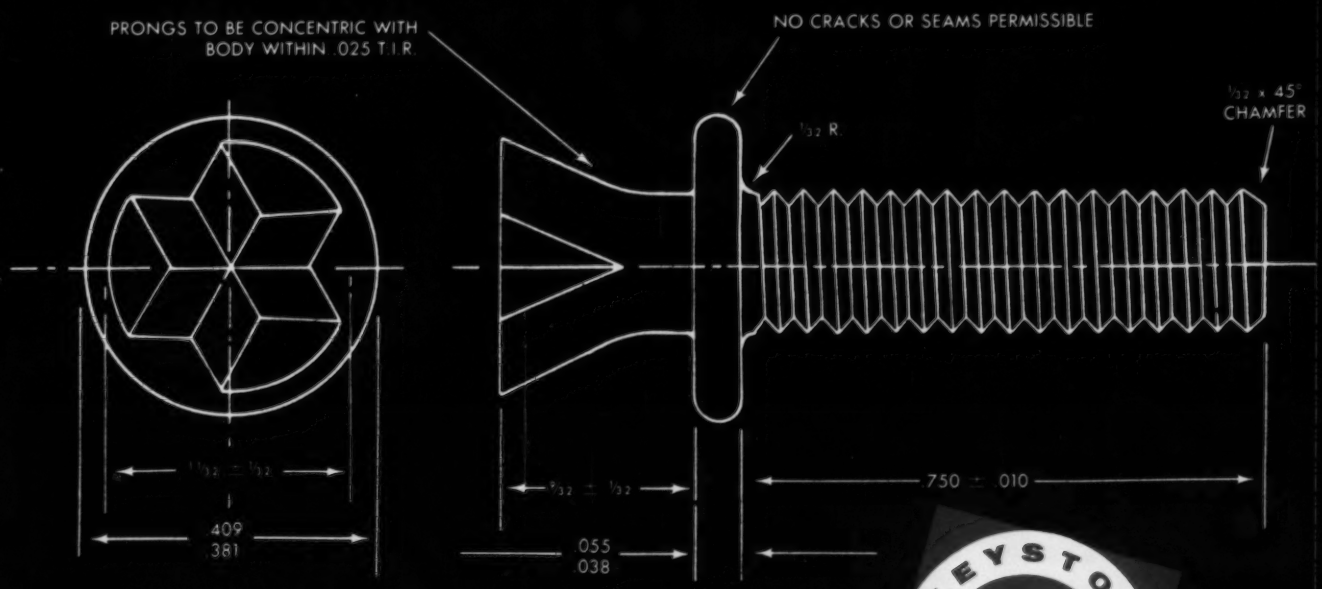
Specialists in Tube Fabricating Machinery

662 WALNUT • AURORA, ILLINOIS

WRITE FOR FREE CASE STUDIES

For news about rotary and press-type machines, tooling, etc., write for copies of PINES NEWS. Catalog also available.

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY



NOTE
1 — USE SPECIAL PRONG AND COLLAR GAUGE #1053
2 — CLASS 2A THREAD AFTER PLATING
MAJOR DIA. — .1891 — .1831
PITCH DIA. — .1688 — .1658

MATERIAL
KEYSTONE XL WIRE
C-1018 — .165 DIA.

KEYSTONE XL WIRE STUDY

10-32 X 3/4
TERMINAL BLOCK STUD

PIONEER SCREW & NUT CO.
MELROSE PARK, ILLINOIS

DIFFICULT — BUT SOLVED
BY PIONEER SCREW & NUT CO.
with KEYSTONE XL WIRE

Faced with a difficult heading problem, Pioneer Screw & Nut Co., Melrose Park, Illinois, uses Keystone XL .165" Cold Heading Wire to upset, in a double blow, the terminal block stud illustrated here. This stud with its three prongs embedded into a plastic strip becomes an electrical terminal stud for such major heavy appliances as stoves, refrigerators, dryers, washers.

Specials from Pioneer Screw & Nut Co. require Keystone XL Wire when flowability for extreme shapes is required, such as this terminal block stud.

Says Robert A. Hirsch, President, "Pioneer's consistent high torque and quality requirements for our special screws are the reasons why we specify Keystone Wire. The end products result in better screws supplied to our customers."

Should you have wire forming problems, send us your blue prints and specifications. Our metallurgists will be pleased to analyze your wire requirements. Or call your nearest Keystone Wire Specialist; he is highly qualified to help you.

Keystone Steel & Wire Company, Peoria, Illinois

KEYSTONE
WIRE FOR INDUSTRY

3 OR 30,000 PIECES

Cut them off MORE ACCURATELY at LOWER COST and FASTER on a MARVEL Hack Saw

1. Accuracy? 2. Speed? 3. Low Cost?

Which is most important in your production or intermittent cutting-off operations? *You get all 3* when your work is handled on a MARVEL Series 6A or 9A Heavy Duty Ball Bearing Hack Saw. Whether you're cutting 3 or 30,000 identical pieces, you can be certain that each piece will be true . . . that it will be cut-off quickly, and at the lowest possible tool cost.

MARVEL Hack Saws are fine machine tools, with all the built-in accuracy this description implies. Designed to operate at higher speeds, with the heaviest feed pressures, they have almost unlimited power and stamina to stand up to the most severe service.

MARVEL Hack Saws are truly multi-purpose cutting-off machines. *No* run is too short or too long, *no* material too mild or too tough to be accurately and efficiently cut-off on a MARVEL Hack Saw.

Catalog C85 has complete details, facts and figures on both Marvel metal cutting Hack Saws and Band Saws. Write for it today.

S-1306

ARMSTRONG-BLUM MFG. CO.
5700 BLOOMINGDALE AVE. • CHICAGO 39, ILLINOIS

MARVEL Metal Cutting SAWS
Better Machines–Better Blades

STEEL
The Metalworking Weekly

Metalworking Week®

October 10, 1960

Steel Exec Says Industrial Summit Meetings Fail

Summit meetings between labor and management, or councils involving management, labor, and public representatives, offer no solution to industrial peace, R. Heath Larry, administrative vice president-labor relations, U. S. Steel Corp., told a Dallas personnel conference. He noted that the summit meetings suggested by Presidents Wilson and Truman were failures. He says the basic problems in collective bargaining that existed when the Wagner Act was passed 25 years ago are still with us.

Executive Shortage Looms

U. S. industry won't have a large enough reservoir of talent to fill its executive needs by 1970, a study by Booz, Allen & Hamilton discovers. New concepts of management and organization, increased specialization of functions, corporate growth, expanding complexity of business, and a trend toward decentralization are mushrooming executive needs. Many industries have three key executives today for every two in 1950. Industry's executive development programs are failing to keep pace, the management consulting firm charges. It says 6 out of 10 company presidents will have to be replaced by 1970, and most presidents have too few, younger, "back-up," executives. In companies where the president is 54 or younger, only 21 per cent of key executives are younger than the president. Even in firms with presidents 55 to 60, only about 55 per cent of key executives are younger than the top man.

Stop Looking at Figures and Start Selling, Challenges Sayre

Judson S. Sayre, chairman, Norge Div., Borg-Warner Corp., says the appliance industry's disappointing sales this year stem from over-reliance on population growth. He says business has become "trapped in the numbers game" this year. He points out that the durable goods industries have been shocked by the failure of the built-in growth factor to deliver automatic sales increases. He declares that growth will depend on the degree of determination and marketing skill put forth by producers, not on "a mythical philosophy that population will generate expanding markets."

Rojtman's Stunts Put Case in Hole

J. I. Case Co. won't wine and dine its dealers in Paris this winter as had been planned. The dealers may even be forced to settle for a visit from a salesman. Reason: The big farm equipment firm is facing a giant credit crisis. The company and its subsidiary, J. I. Case Credit Corp., owe about $180 million to 91 banks. And the bankers have put their collective feet

Metal Show Section—Page 125 Market Outlook—Page 219

down. They have agreed not to press payment claims for a year, but demand that the company not squander any funds. They blame promotion-minded Marc B. Rojtman, ousted president of the firm, for the financial difficulties. He pushed the company's sales from $87 million in 1956 to $200 million in fiscal 1959, via easy credit and million dollar parties for dealers. But bank borrowing climbed from $72 million in 1957 to $233 million in 1959.

Construction Held High in September

New construction put in place during September totaled $5.3 billion, the Commerce Department reports. That's a seasonally adjusted annual rate of $55.4 billion—up 1 per cent from the August pace and about equal to the September, 1959, rate. By segments, it looks this way:

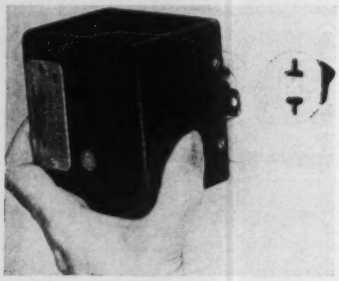
	% Change, Sept., 1960, vs. Aug., 1960	Sept., 1959
Private	...	− 4
Residential	−1	−13
Industrial	+4	+39
Commercial	+2	+ 2
Farm	−3	+11
Public utilities	+2	+ 5

	% Change, Sept., 1960, vs. Aug., 1960	Sept., 1959
Public	+3	+ 9
Residential	+3	− 8
Nonresidential	...	+15
Military	+2	−12
Highways	+7	+13
Sewer & water	−1	− 1

Steel Buyers Won't Step Up Demands

The men who buy steel for large corporations see no recovery in the fourth quarter that could lift the operating rate much above the present range. And most of them see no appreciable pickup in steel demand during the first quarter of 1961. So finds a survey by National Association of Purchasing Agents.

Plug-In Unit Is OCDM's Latest Warning Medium



This "national emergency alarm repeater" can be plugged into a household electrical outlet. Developed for the Office of Civil & Defense Mobilization, it will buzz and light up to warn of enemy attack or natural disaster. The warning signal will be carried over conventional power lines. OCDM says every home in the nation can be contacted in about a minute.

Chrysler Affair: Is the End the End?

Chrysler closed the door on the Newberg affair last week, with a report that no further conflict of interest had been uncovered. Detroit observers think, however, that stockholder Sol Dann has only temporarily stopped hurling charges. Rumor has it that Mr. Dann is continuing an investigation, and if he finds any further evidence, will reopen the affair at an opportune time—a stockholders' meeting, for example. STEEL also learned that two persons not connected with Chrysler or Mr. Dann are carrying on their own investigation.

GM Probes Conflict of Interest

General Motors Corp. is questioning all executives and employees involved in procurement for possible conflicts of interest involving suppliers. GM has distributed questionnaires to officers, general managers, staff men, and all em-

ployees involved in purchasing of goods and services. The firm started issuing the queries several weeks ago, asking employees to keep the matter confidential. GM has now admitted the probe, but it has not released any findings.

Burroughs Unveils New Desk Computer

Burroughs Corp. has introduced a new, general purpose, desk size, electronic digital computer—the E103—which will sell for $29,750. Aim: Widen the EDP market among smaller businesses. Burroughs also cut the price of its E101 scientific and engineering computer to $26,750 from $38,325. Simplified programing permits minimum operator training.

New Auto Guarantees: Challenge to Metalworking?

The trend to higher reliability in consumer goods, spotted by STEEL some time ago (See STEEL, Feb. 29, p. 80) and encouraged since (STEEL, Apr. 25, p. 59, Sept. 26, p. 73) is now in the open. Carmakers have tied themselves to guarantees for 12 months or 12,000 miles. Industry observers see the move as a challenge to the appliance industry—and all metalworking companies—to improve the dependability of their products.

Taxes Total $100 Billion

Taxes collected by all governments in the U. S.—federal, state, and local—in their fiscal years ended during 1959 totaled $100 billion (vs. $98.4 billion in 1958), the Commerce Department reports. Tax yield per capita hit $567.04 last year. Here's how the $100 billion were spent . . .

National defense and international relations	38.8%	General administration	2.2%
Education	14.7%	Air & water transportation	1.5%
Highways and streets	7.8%	Police protection	1.5%
Natural resources	7.4%	Sanitation	1.4%
Interest on general debt	5.6%	Local fire protection	0.8%
Health and hospitals	4.2%	Housing & community redevelopment	0.7%
Public welfare	3.3%	Local parks & recreation	0.6%
Postal service	2.8%	All other	6.8%

Employees Waive Wage Hike, Living Costs

Employees of Damascus Tube Co., Reynolds, Pa., have approved a contract with no wage increase for 12 months and have waived the cost of living increase agreed upon a year ago. The goal is to give the firm an opportunity to build a stronger fiscal base. Employees are represented by an independent union.

Carey Denies Statement Made to STEEL

James B. Carey, president of International Union of Electrical Workers, now denies that he ever said: "I owe GE a strike." That statement was reported in STEEL and has been used by General Electric Co. in its full page newspaper ads presenting its side of the IUE strike. In an interview 15 months ago

with Mr. Carey in IUE's Washington headquarters at 1126 16th St. NW, he made the disputed statement during the course of an hour and three quarters' session with Jack Botzum, STEEL's Washington editor. This is the first denial of that statement we have heard from Mr. Carey since we reported it July 27, 1959, p. 71.

Administration Begins Pump Priming

The Commerce Department has made available—immediately—$718 million in federal funds for the highway program. The money was previously set aside but was not to be available for obligation before Jan. 1, 1961. Commerce Secretary Frederick H. Mueller has denied that his department made any report to the President that the economy is in a recession. But the unleashing of the highway funds indicates concern in Washington—both about the economy and the November election.

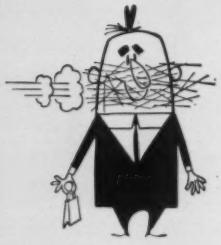
Westinghouse Will Air Condition Complete Suburb

Westinghouse Electric Corp. and Levitt & Sons Inc. have signed a $6 million contract to air condition a complete suburb—4500 homes in Bel Air, Md., between Baltimore and Washington. The contract covers heating, air conditioning, and appliances.

Japan's Electronic Industry Booming

Japanese output of electronic products in the first quarter totaled $282.1 million—up 53 per cent from the like 1959 period, says the Commerce Department. Biggest gains were registered by semiconductors (up 67 per cent), electron tubes (up 63 per cent), radio receivers with three or more transistors (up 95 per cent), TV sets (up 59 per cent), and recorders (up 58 per cent).

Straws in the Wind



White Motor Co. has purchased Oliver Corp.'s farm equipment business . . . New construction in the coming decade will total $670 billion, predicts W. W. Sproul Jr., vice president, Westinghouse Electric Corp. . . . Pennsylvania Electric Co. last week placed in operation 13 miles of 460,000 volt transmission line, surpassing Russia's 410,000 volt line to become the world's highest voltage operating line . . . The Tariff Commission has advised the President against any change in the present quota system limiting imports of lead and zinc metal, concentrates, and ores.

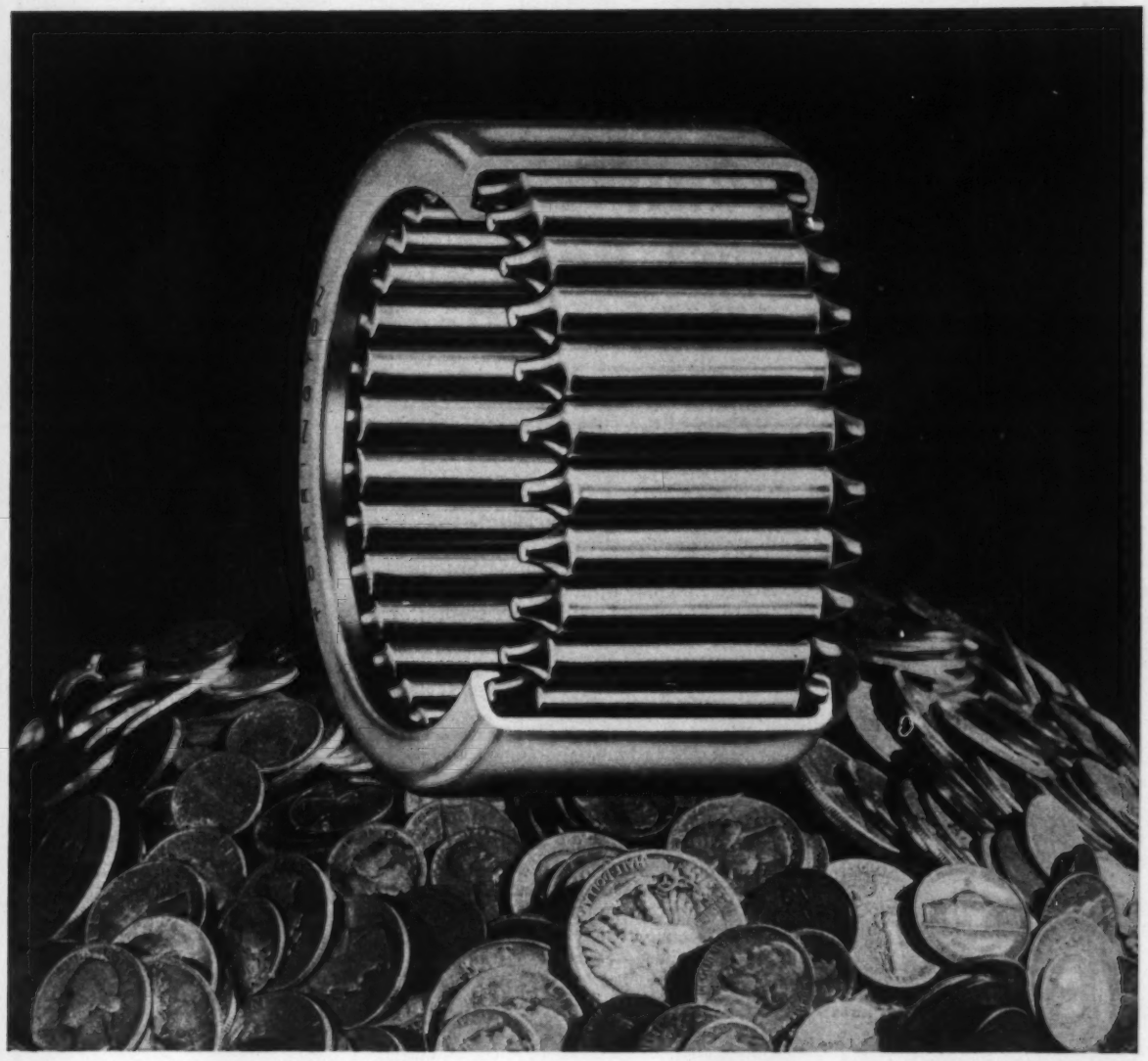
Metalworking Pulse

The Business Trend: Early and vigorous buildup in 1960 model auto output pushed STEEL's index to the highest point since late July. **Autos:** Only Chrysler Corp. is cutting back on October schedules so far. The other producers are sticking to original plans, which would result in 663,600 units this month. **Steel:** A railroad strike at Bethlehem's Lackawanna, N. Y., plant is the main reason for a drop in industry output to 1.5 million tons.

- **INDUSTRIAL PRODUCTION**
  - Week ended Oct. 1 . . . . 153†
  - Year ago 117
  - Details on Page 101
- **PASSENGER CAR PRODUCTION**
  - Week ended Oct. 8 . . 140,000*
  - Year ago 118,793
  - Details on Page 97
- **INGOT PRODUCTION RATE**
  - Week ended Oct. 9 . . 52.6%†
  - Week ago 54.7%
  - Details on Page 228

†Preliminary. *Estimated.

Copyright 1960 by STEEL, Penton Building, Cleveland 13, Ohio



Savings Pile Up With Torrington Needle Bearings

You get performance-plus at a low, low unit cost when you specify Torrington Needle Bearings. A full complement of small-diameter rollers provides a maximum number of contact lines. The result—a higher radial load capacity at a lower unit cost than any other bearing of comparable size or performance.

Precision rollers operate smoothly and efficiently, with a low coefficient of starting and running friction. Positive roller retention is insured by turned-in lips on the outer shell, permitting faster and easier installation or assembly.

Your Torrington representative is an expert on Needle Bearings. For full information on how they can bring savings and improved product design and performance call Torrington—maker of every basic type of anti-friction bearing.

TORRINGTON NEEDLE BEARINGS FEATURE:

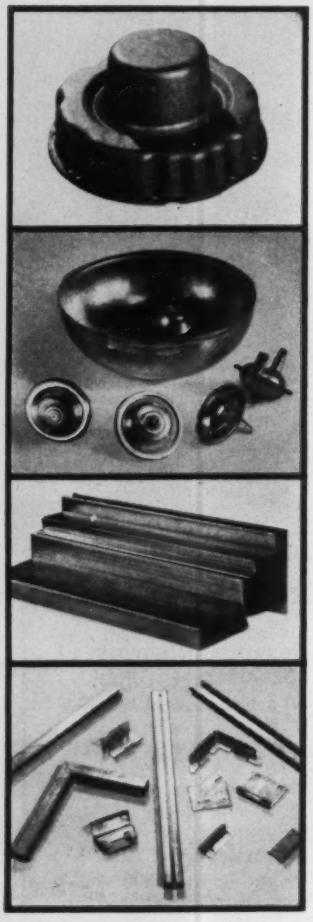
- Full complement of retained rollers
- Unequalled radial load capacity
- Low coefficient of starting and running friction
- Low unit cost
- Long service life
- Compactness and lightweight
- Runs directly on hardened shafts
- Permits use of larger and stiffer shafts

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY Torrington, Conn. • South Bend 21, Indiana

Armco ZINCGRIP Steel Protects Against Rust and Corrosion at Minimum Cost

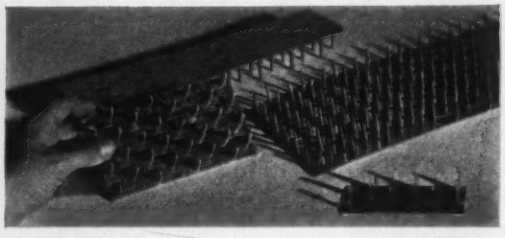
Special hot-dip zinc coating that doesn't flake or peel gives formed steel parts economical durability.



If you are making parts like these—parts that require the strength of steel yet must have low cost protection against rust—Armco ZINCGRIP Steel offers you opportunities to save money and improve product performance. Here's why:

* **ZINCGRIP STEEL has the lasting protection of a full-weight hot-dip zinc coating (1.25 oz. or heavier).**
* **The special coating on ZINCGRIP won't flake or peel despite forming, drawing, piercing, or other severe working.**
* **Armco's patented continuous process produces a zinc coating of uniform thickness and composition.**
* **For only a few cents' premium over cold-rolled steel, you eliminate the need for plating, painting or other protection.**
* **The economy and durability of ZINCGRIP STEEL has been service-proved in thousands of applications for more than 25 years.**

Let us send you complete information on Armco ZINCGRIP Steel so you can determine how its advantages can be most effectively used in *your* products. Armco Steel Corporation, 2370 Curtis Street, Middletown, Ohio.



New steels are born at Armco

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

How to Meet Competition!

A leading machine tool builder tells us he had 25 suppliers of gray iron castings a few years ago.

Now he has five.

The other 20 foundries are out in the cold, and with present practices, they have little chance of getting back in.

The reason: The machine tool builder found it tougher and tougher to meet competition.

So he was obliged to improve the designs of his machines, which meant, among other things, higher quality castings for beds, carriages, and slides.

When it came to producing the castings the machine tool builder wanted, only five foundries could deliver.

That example of not keeping up to date may be repeated time and again in other industries. Many companies in many industries are losing ground to the new materials, new processes, and new fabrication methods that are capturing the fancy of management, product planners, and engineers.

Fortunately, some industries are beginning to fight back.

The gray iron foundry industry is an example.

Stimulated by its association, the more aggressive foundries are adopting or considering more productive equipment, such as water cooled cupolas and automated material handling equipment.

The industry also plans to dispel the misconception that products made of cast iron necessarily must be heavy and brittle.

It will show, for instance, that higher strength castings can be made with lighter, thinner sections; that cast iron which will bend without breaking can be made; that integral castings requiring less machining can replace multiple components.

The gray iron industry, we feel, has a constructive approach to the problem of meeting competition.

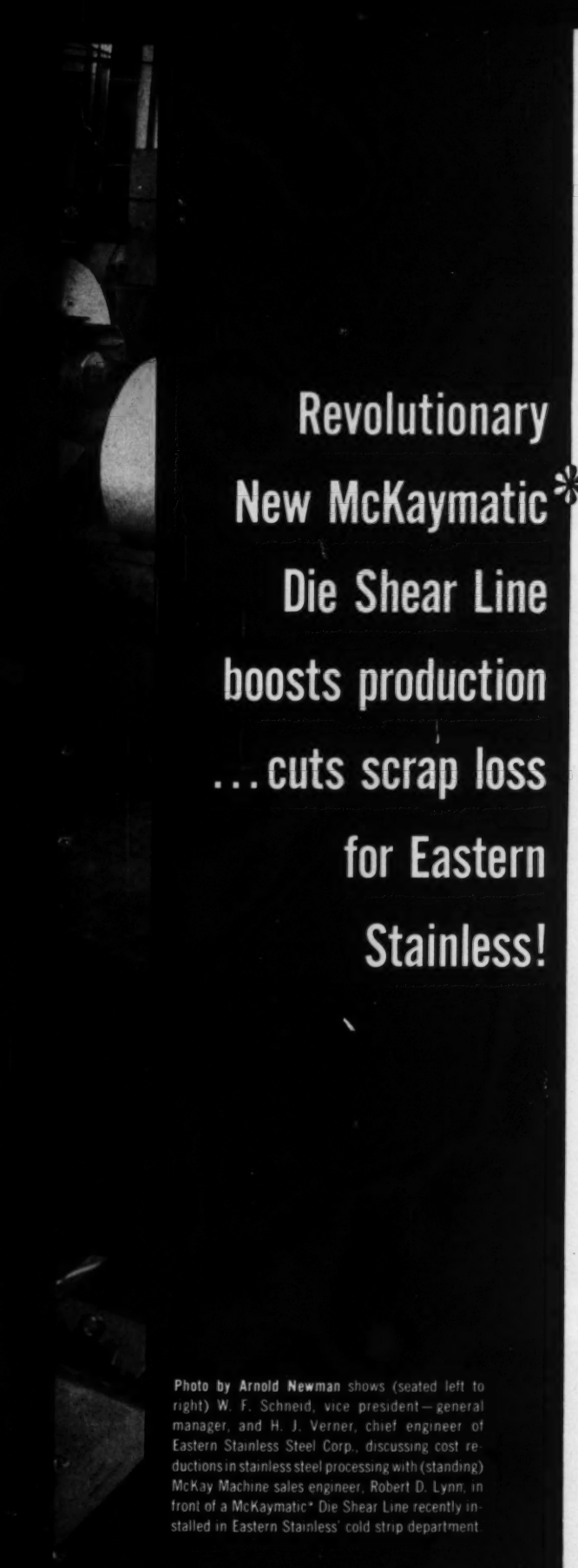
But it means that every company within the industry must keep in stride with changing technology and changing markets.

Not only that. There's a sobering thought for everyone here: Remember that somewhere, someone is working on something designed to put your company out of business!

Irwin H. Such

EDITOR-IN-CHIEF

McKAY



Revolutionary New McKaymatic* Die Shear Line boosts production ...cuts scrap loss for Eastern Stainless!

"We consider the McKaymatic* the finest advancement in shearing to come along in a great many years," says W.F. Schneid, vice president-general manager, of Eastern Stainless Steel Corporation, Baltimore, Md. "We have reduced production time, cut our scrap loss, and have recorded an overall increase in department efficiency as a direct result of this new McKay die shear line," Mr. Schneid continues.

Eastern Stainless is a prime supplier of stainless steel sheets, strip and plates, for aircraft and missile parts, for food, chemical, paper and textile machinery and for architectural uses. It produces 25 grades of stainless steel in its own modern electric furnace facilities, and ships about sixty-six percent of it in sheet form.

Programs many grades instantly—Through improved roller leveler techniques, Eastern Stainless found it was able to instantly program many grades of sheet through its new McKaymatic* Die Shear Line. The line decoils, levels in a 17-roll McKay Roller Leveler, measures by electronics and cuts to length—replacing a cut-up, re-level, and re-square operation prior to boxing. Production of cut lengths has been substantially increased.

The result, they report, is cost savings. Says Mr Schneid: "As a result of our efforts to improve customer service, we installed this line to speed up production of these cut lengths. It has enabled us to break a production bottleneck for which there seemed to be no solution."

Line eliminates stretcher leveling—Mr. Schneid continued that production time has been reduced on sheets of five grades as a result of being able to eliminate stretcher leveling and re-squaring procedures. Also, he said, the scrap loss on re-squaring has been eliminated as the sheets are cut clean and square on the McKay line. Net effect of the installation was a definite increase in overall departmental efficiency.

H. J. Verner, chief engineer, remarked that the McKay roller leveler could process these grades of stainless, within its capacity, to flatness approaching that obtained from the stretcher method. He reported that the Die Shear Line is being used to prepare for shipping cold rolled sheet from 4" to 48" in width, up to .050" in thickness, and in lengths from 36" and greater at normal production speeds. He particularly likes the McKaymatic* Die Shear Line for its ability to handle high finish stainless without edge or surface damage.

Available in many sizes—The McKaymatic* Die Shear Line is available in sizes to accommodate most commercial widths. Composed of decoiler (with coil car, if desired), roller leveler, measuring device, and cutoff press, it satisfies most requirements for sheet length accuracy and squareness, flatness, edge and surface quality protection and output rate.

For short runs or long, the McKaymatic* Die Shear Line will better any other line in economy and efficiency. Whatever your cut-to-length problem, McKay Machine's engineers have a solution. Write for literature; send your specific needs for a quotation to *McKay Machine Company, Youngstown 1, Ohio.*

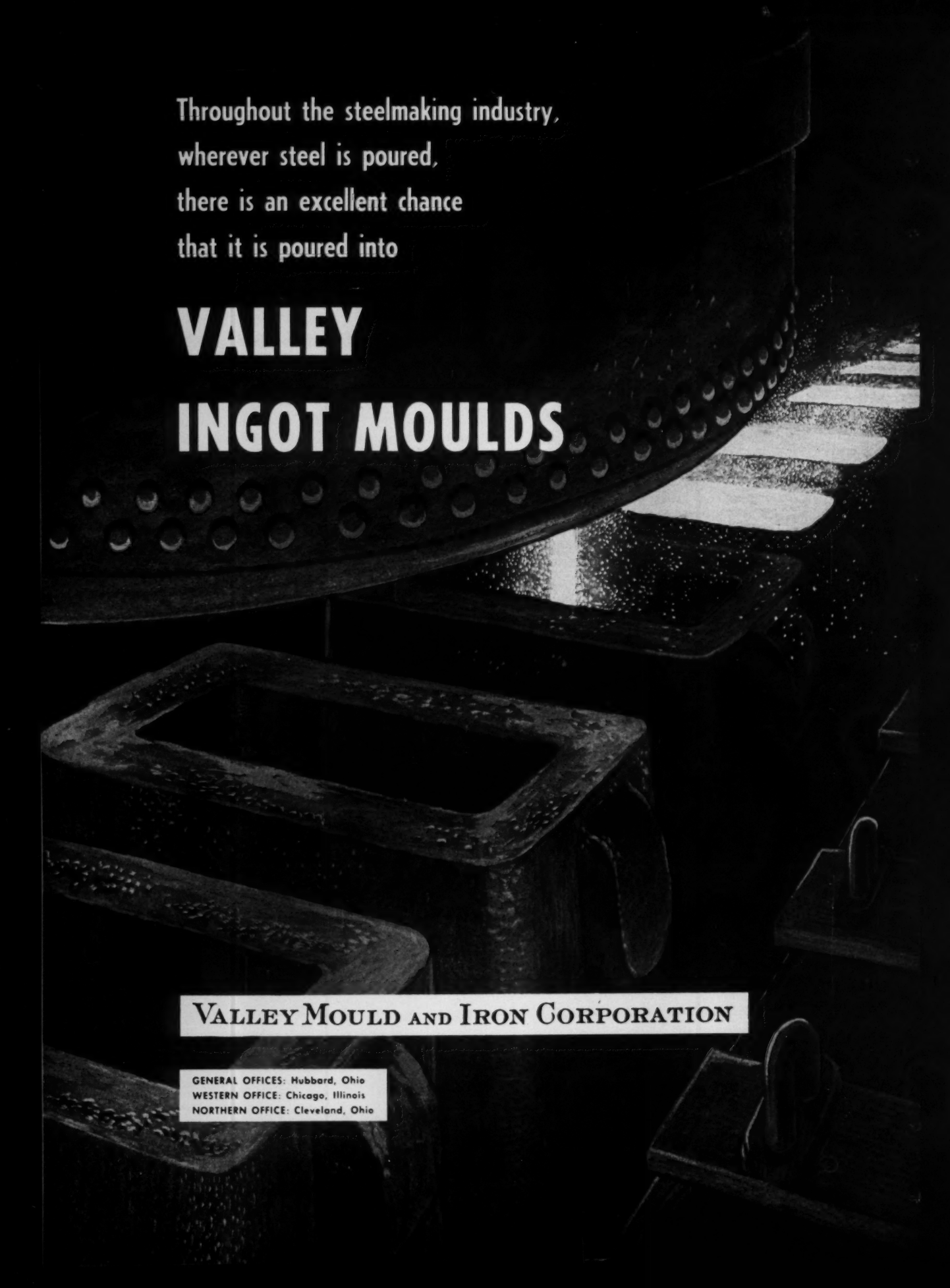
*TM

Photo by Arnold Newman shows (seated left to right) W. F. Schneid, vice president—general manager, and H. J. Verner, chief engineer of Eastern Stainless Steel Corp., discussing cost reductions in stainless steel processing with (standing) McKay Machine sales engineer, Robert D. Lynn, in front of a McKaymatic* Die Shear Line recently installed in Eastern Stainless' cold strip department

LOOK TO

McKAY MCK MACHINE

FOR PROGRESS IN METAL PROCESSING



Throughout the steelmaking industry,
wherever steel is poured,
there is an excellent chance
that it is poured into

VALLEY INGOT MOULDS

VALLEY MOULD AND IRON CORPORATION

GENERAL OFFICES: Hubbard, Ohio
WESTERN OFFICE: Chicago, Illinois
NORTHERN OFFICE: Cleveland, Ohio

Equipment Order Trend Edges Up

	Aug. vs. July	Sept. vs. Aug.	4th Quarter vs. 3rd Quarter
Machine tools	Up	Up	Up
Presses	Down	Up	Up
Foundry equipment	Up	Up	Up
Welding equipment	Down	Up	Up
Material handling equipment	Down	Same	Same
Heat treating equipment	Up	Same	Same
Steel mill equipment	Same	Same	Same
Finishing equipment	Same	Same	Down*

*Largely seasonal. Source: STEEL survey.

Equipment Sales—No Sharp Decline

DON'T LOOK FOR a sharp decline in spending for capital equipment, despite the current rash of downturn predictions.

The downturn is to occur, so the argument goes, because capacity is ample, profits are disappointing, and the spending curve leveled off in the third quarter.

But a closer look reveals holes in that argument. Listen to James M. Dawson, vice president and economist, National City Bank of Cleveland, point out some of them.

"Ample capacity by itself need not bring cutbacks in capital spending. Outmoded, inefficient, noncompetitive facilities represent capacity which smart management replaces rather than retains. Significantly, some two-thirds of current spending is for modernization versus one-half in 1957.

"There was ample capacity in the economy at the start of 1959 and yet plant and equipment spending for that year exceeded 1958 outlays by 7 per cent," Mr. Dawson continues. "There was ample capacity at the start of 1960, and yet spending this year will total 11 per cent more than last year. It is interesting that the steel industry, which obviously has ample capacity, is spending 50 per cent more this year than last."

• **Two Good Indicators**—Mr. Dawson asserts that corporate cash flow is a more important factor in determining the capital spending trend. This year's corporate outlay is matching retained earnings plus depreciation; outlays were greatly exceeding such funds prior to the last two recessions. So Mr. Dawson concludes: "Since capital spending is not excessive relative to corporate cash flow, presumably it is not as vulnerable to decline."

Capital spending is also conservative relative to the over-all economy. Equipment outlays this year will be about 5.75 per cent of the gross national product. That compares with 6.5 per cent prior to the last two recessions. Says Mr. Dawson: "Here again, the absence of excess suggests capital spending is less subject to decline than in previous economic adjustments."

• **Easier Money Helps**—The Federal Reserve Board's switch to easier credit should give a lift to equipment buying. The supply of loanable funds was at its lowest level in September since March, 1934, the Alexander Hamilton Institute reports. But there's plenty of money available for investment in new facilities by soundly managed com-

panies. And now the interest rate is at a level that makes borrowing more attractive.

• **Slim Margins Force Trimming**—The prophets of a spending downturn point to disappointing profits as proof for their predictions. But look at the reason for the decline in profits. The chief cause is lower margins, not poor sales volume. So sharp managers will be concentrating on widening profit margins during the next six months. Many of them are bound to turn to investment in more efficient production facilities to solve the problem.

• **Good Time to Buy**—Another factor is brought forth by J. R. Sebastian, president, Rapids - Standard Co., Grand Rapids, Mich. He reports that some customers are buying conveyor equipment now because it's easier for them to install the equipment while their production volume is below average.

• **Upturn Signs**—Some signs point to an upturn in equipment orders. Metal cutting machine tool orders, for example, climbed in August to the highest point of the year. That surprised most observers, who expected buyers to wait until after The Machine Tool Exposition—1960, in September, to open their purse strings. Some of the buying in August is attributed to anticipation of price hikes in September. But most observers say the orders were for new machines that were privately shown before the machine tool show. Interest generated by the show is expected to push orders in the fourth quarter up some 20 per cent above the third quarter volume.

• **Odds Favor Plateau**—Most factors signal a sidewise movement in equipment spending from now till mid-1961. The economy probably won't support any boom-type buying before then. Arthur O. Dahlberg, president, U. S. Economics Corp., thinks plant and equipment spending will run at an annual rate of $36.9 billion in the last quarter of this year. He sees the 1961 trend shaping up like this:

1st Quarter	$36.3 billion
2nd Quarter	37.3 billion
3rd Quarter	37.9 billion
4th Quarter	38.8 billion

• **Inquiries High**—In a spotcheck of equipment builders across the country, STEEL found considerable optimism—based mostly on a huge volume of inquiries. The builders believe almost all the inquiries represent serious buying intentions. Examples:

• "We're getting a considerable volume of inquiries representing serious interest, but the uncertainty in the economy is inhibiting placement of orders"—Ralph W. Miller, financial vice president, Lodge & Shipley Co.

• "Estimating is at an all-time high, but many plans are being pigeonholed"—J. L. Pischke, president, American Monorail.

• "Proposals are way up. If quotations turn into orders, the last quarter will be a good one"—F. H. Chorman, executive vice president, May-Fran Engineering Inc.

Prices are fairly soft in most lines of capital goods and customers are doing plenty of shopping before placing orders.

• **Prediction**—In previous postwar recessions, capital spending declined an average of 12 per cent. "There are valid reasons for assuming that, if a 1961 setback does occur, it will be milder than the others. If so, any cutback in capital spending likewise should prove moderate," concludes Mr. Dawson.

Copper Price Drops

THE COPPER MARKET broke last week after seven months of price stability. Custom smelted copper is being quoted at 31 cents per pound, 2 cents below the level set Mar. 10.

Behind the drop: A high production rate that has been buoyed by fears of disruption in the Congo and threat of labor trouble in Chile—not by demand.

Also, European prices had fallen, and foreign copper was being set down in U. S. ports for 2 to 3 cents under domestic prices. Historically, custom smelters drop prices to meet competition.

It's unlikely that primary producers will make an early move to follow suit and drop their 33 cent quotations. Most market observers feel they'll wait out the market for a while. But if no improvement develops, they'll be under strong pressure to lower prices.

New Furnace Cuts Heat Treating Time by 85%

A FLUIDIZED BED furnace that promises an 85 per cent reduction in heating time compared to a typical radiation or forced convection furnace will be demonstrated by General Electric Co. next week at the National Metal Exposition in Philadelphia.

Parts being processed in the furnace are surrounded by a dense dispersion of solid refractory particles suspended by a controlled stream of heated atmosphere.

The fluidized particles have virtually the same physical and thermal properties as a true liquid, officials explain, except that they will not wet, abrade, corrode or otherwise affect the equipment or the work.

GE specialists say the new batch type furnace which heats to 1700° F in work areas to 4 ft by 8 ft can produce savings in processing times and costs for annealing, aging, solutionizing, normalizing, stress relieving, hardening, and isothermal transformation treatments.

The heat transfer rates that make the furnace a good heating medium also make it a good quenching method. By varying the size, shape and type of refractory particle, and the flow rate, you can adjust the heat transfer properties and hence the quenching rate to any value intermediate to air and oil.

Temperature uniformity around the work and throughout the work area is another benefit of the fluidized bed. There are no temperature gradients in the work area.

Ore Stocks Near Winter Level

LOOK FOR the Great Lakes ore fleet to tie up by mid-November, or earlier, this year.

Reasons: Iron ore inventories are high, and the steel operating rate isn't expected to average more than 60 to 65 per cent of capacity over the winter months.

• **Supply**—Ore stocks totaled 70.5 million net tons on Sept. 1. Steel industry economists foresee the operating rate gradually rising in this quarter and hitting a peak of 65 per cent in November or early December.

The operating rate in the first quarter of next year is expected to average 60 to 65 per cent. During that period, it's possible that the rate could go as high as 70 per cent.

That rate, plus anticipated ore receipts (both domestic and foreign), should give the industry an ore stockpile of about 55 million tons on Apr. 1, 1961.

Some industry officials feel that the stockpile could reach 60 million tons.

Last year, the lake ore carriers got a break weatherwise and were able to operate until mid-December, stockpiling ore for the high level steel operations in the first quarter this year. Last month, the lake fleet (231 ships with a trip capacity of 3.2 million net tons) was operating at only 60 per cent of capacity.

• **Canadian Concern**—The slowdown in steel operations in the U. S. has created some concern in Canada because we are her biggest customer. It will keep the Canadians from realizing earlier iron ore expansion projections. In addition, South American countries are becoming highly competitive. Brazilian ore, for example, often runs more than 60 per cent in iron content vs. the 38 per cent average for Labrador-Quebec ores.

Of the ore received so far this year, 69 per cent has come from domestic sources, 10 per cent from Canada, 21 per cent from other foreign sources.

Iron Ore Stocks vs. Consumption

(Millions of net tons)

Total iron ore inventory, Sept. 1	70.5
Expected ore receipts, Sept. 1 through Apr. 1	42.0
	112.5
Expected ore consumption, Sept. 1 through Apr. 1	57.5
Total ore on hand Apr. 1, 1961	**55.0**
Inventory Apr. 1, 1960	39.2
Inventory, Apr. 1, 1959	43.2
Inventory, Apr. 1, 1958	51.8

Association Membership Can Pay Off

IF YOU WANT to get more out of your trade association investment, the best way to do it is to step up your participation in its activities.

That's the advice of veteran trade association executives. "The benefits are here to be had," declares one. "But we can't spoon-feed our members. We find that a company benefits almost in direct proportion to the amount of work it contributes in committees and other activities."

• **An Investment**—The officials declare that a company should regard its dues as it does any other investment. One Midwest firm told STEEL that it annually pays dues amounting to 1 per cent of net profits for company memberships alone. (That's enough to pay the salaries of 15 fulltime executives.) In addition, it supports many other groups through individual memberships.

The competition for your dues is becoming greater each year. Jay Judkins, chief of the Trade Association Division, Office of Technical Services, Department of Commerce, estimates that this year there are about 2000 national associations of businessmen vs. 1350 in 1940. Metalworking participates in about 350. And most of them are driving for greater membership to support expanded programs.

For instance, the American Marketing Association is out to enlist the support of an additional 500 company sponsors. Association officials say that the changing concept of marketing is stimulating the need for greater exchange of ideas and creative thinking. Greater membership will enable AMA to do more basic research into the scope, techniques, and development of the concept.

In choosing which associations you want to join, keep in mind that, with minor exceptions, few are alike. "That is their prime characteristic," declares Guenther Baumgart, president of American Home Laundry Manufacturers Association (AHLMA). "There are common problems and techniques, but it is a bond of specific interests that makes each one unique."

• **Rate Your Association**—To make sure you have made a wise choice, put your association to this test:

1. Does it represent a large enough percentage of the industry to be effective?
2. What percentage of top industry personnel is active in committee work?
3. Is it adequately financed with a sound budget, and are dues equitable for size of company and nature of interest in the association?
4. Is it adequately staffed with well trained executives?
5. Does it maintain close contact

What Are You Getting for Your Association Dollar?

Here are the services most commonly offered by industry associations. To find out if you are getting your money's worth, score each service with 3 for good, 2 for fair, 1 for poor, and 0 for none.

- ☐ 1. Statistics for industry production, sales, orders, or backlogs.
- ☐ 2. Public relations programs.
- ☐ 3. Technical and industrial research.
- ☐ 4. Traffic and transportation information.
- ☐ 5. Representation in legislative matters of concern to industry.
- ☐ 6. Labor relation programs.
- ☐ 7. Foreign trade promotion.
- ☐ 8. Information concerning financial practices.
- ☐ 9. Conventions, seminars, workshops, training sessions.
- ☐ 10. Literature of interest to the industry or management in general.
- ☐ 11. Sales promotion through advertising, publicity, or trade shows.
- ☐ 12. Marketing or commercial research.
- ☐ 13. Information on uniform cost accounting methods.
- ☐ 14. Standardization, simplification, inspection, grading, certification programs.
- ☐ 15. Advice on legal matters.
- ☐ 16. Code of ethics.

If your score is 32 to 48, you have a bargain; 16 to 32, you are probably getting a fair return; below 16, you may be getting a specific service you want, but you're not getting full value.

LOWELL D. RYAN

Ad Program Pays Off for Founders

MEMBERS of the Malleable Founders' Society are effectively using their trade association to carry on a major marketing program which members probably couldn't do individually.

"As an industry, our membership blankets the major metalworking markets," explains Lowell D. Ryan, executive vice president of the society. "For several years, our share of the ferrous components for those markets had been slipping. It seemed like an ideal situation for a co-operative campaign based on the same principles as those underlying the trade association—pooling the cost and sharing the benefit.

"Two years ago, our advertising arm, the Malleable Castings Council, was formed to provide an avenue for our members—and others in our industry—to participate in a top quality ad program. In two years, the cost has been about $400,000. The results are gratifying. The downturn in market penetration has been turned. Although we can't prove the ad program was the sole contributing factor, we feel it played a big part."

The program has had a tremendous effect on customers, adds Charles P. Speitel, president of Pennsylvania Malleable Iron Corp. and president of MFS. "In addition, there's new enthusiasm in our sales effort and a more positive feeling about where we are going as an industry."

Recognizing publicity as an essential adjunct to advertising, the society has given this program added emphasis. For 1961, the Malleable Castings Council plans an even bigger program (another $200,000 ad budget) and will include college engineering periodicals in its coverage in an effort to influence future potential users.

with associations in related fields?

6. Does it maintain adequate field services?

7. Does it encourage competition among its members and also provide answers to common problems?

• **It's a Bargain**—If you score well in the quiz on Page 84 and can answer most of the questions above affirmatively, you have a bargain. Declares Orrin B. Werntz, executive secretary of the National Screw Machine Products Association (NSMPA): "If a businessman would join an association and use it, he wouldn't leave it except for personal reasons. Even the small company can afford to belong to a good trade association. It costs less than you'd pay your floor sweeper. If you were to run a profit-loss statement on direct benefits, you'd come up with a 100 per cent profit on your dues."

• **Pays Off**—One small manufacturer of screw machine products relates that he used the wage and fringe benefit figures developed by his association (NSMPA) in negotiations with his union. These data showed that the union was seeking benefits far greater than the industry as a whole received. He got a contract which saved him $40,000.

William L. Hullsiek, merchandising manager for Kelvinator Div. of American Motors Corp. states: "As a company, we could not begin to get, at a commensurate cost, the benefits and information we get as a member of AHLMA. In fact, some of the things we could not get at all by ourselves."

• **Different Kinds** — Many of the benefits are indirect, say veteran association officials. For instance, some offer to arbitrate differences between members or members and their customers, preventing loss of good will. (The chief reason why most companies drop association memberships, in the opinion of one executive: Personality clashes.)

Another claims that the biggest benefit from any association is the opportunity to get together and talk over common problems or goals.

• **No Alternative**—But whether you measure the return on your investment directly or indirectly, those who are most active in trade association affairs conclude it is not a question of whether or not you can afford to be a member. They claim you can't afford not to if you want to improve your industry position.

Cuba Goes One Way

After making export tax demands that the U. S. considers confiscatory, Cuba's Castro has taken over the Nicaro nickel facilities. There'll be no shortage, however, because world capacity is expanding. Most Cuban nickel will end up in the Soviet Bloc

THE LAST STRONGHOLD of U. S. investment in Cuba—the $110 million, U. S. owned, Nicaro nickel mining and processing complex—has fallen victim to Castro.

It has joined the ranks of the oil refineries, sugar mills, hotels, banks, and ranches that can be written off as long as Castro's government remains in power.

• **Price Too High**—After months of fruitless negotiations between U. S. and Cuban officials, talks broke down. The Cubans told the State Department that effective Oct. 1, all shipments of nickel would be subject to a 25 per cent export tax based on the highest selling price of nickel in the world. Terming the tax "confiscatory," the U. S. ordered the plant closed.

Almost immediately, Cuban officials, with the aid of militia and unions, took over direction of the sprawling facilities that employ 2800 workers.

Cuba made it plain it was in no mood for compromise. After its token offer to buy the plant for $4.5 million was turned down, the U. S. reiterated its earlier proposal to pay up to $1.5 million a year in taxes. That too was rejected.

• **Where We Stand**—The U. S. is poised for early retaliation. As STEEL went to press, Washington officials were privately predicting early enactment of stringent export controls that would prohibit shipment to Cuba of a wide range of items—particularly machinery and replacement parts that could be used at Nicaro and the seized U. S. oil refineries and chemical plants. Commenting on the possibility of a complete break in diplomatic relations, one observer said: "It's not a question of will we, but when."

• **No Nickel Shortage**—Loss of Nicaro cuts off the potential flow of 54 million lb of nickel a year to the U. S. market. In mid-August the other U. S. nickel facility—Freeport Sulphur Co.'s new, $75 million, complex—was seized by Castro.

No nickel shortage is seen at this time. Free World capacity has been steadily rising and will stand at 595 million lb next year when International Nickel Co. brings its new, $75 million plant into operation at Thompson, Man.

Loss of Nicaro will be felt most by the steel companies that have been using its nickel oxide sinter. Fortunately, a considerable tonnage was shipped from the plant during the last few months, and Nicaro stocks in this country total about 32.5 million lb. That is enough metal to supply customers for more than a year at the present consumption rate.

The U. S. owns a nickel facility in Riddle, Oreg., which is operated by the M. A. Hanna Co. The bulk of production goes to the U. S. under a contract which runs until June, 1962, or until 125 million lb of contained nickel have been delivered, whichever comes first.

Currently, the Riddle plant is operating at a rate of 18 million lb a year. All production is going into the U. S. stockpile.

Hanna says it's undecided about what it'll do when the government contract ends.

• **Can They Run It?**—During 18 years of operation, the Nicaro plant has fed $80 million into the Cuban economy. Castro will be under great pressure to keep the plant running, but because of the complexities of the facility, it may prove difficult for the Cubans. If Castro can get parts, supplies, and technicians elsewhere, he might be able to swing it.

The Nicaro facilities include: A metallurgical extraction plant with a capacity of 54 million lb annually; ore reserves estimated at 32 million to 35 million tons; mining and ore transportation facilities; a laboratory and pilot plant; and warehouse and storage facilities.

Speculation is that Castro will receive the help and supplies he'll need to run the operations from the Communists. It's no secret that the Soviet Bloc is nickel shy. There have been persistent rumors that Castro and the Russians have been talking trade—Cuban nickel for Red machinery and technical aid.

Cuba Seeks Stronger Ties With the Soviet Bloc

Cuba's Marxist-minded economic czar, Maj. Ernesto Guevara, flew to Moscow last week, reportedly trying to engineer another sweeping trade deal with Russia.

The deal, reports a Washington source, would offer Cuba's entire sugar crop in the years ahead to the Soviet Bloc in exchange for goods ranging from penknives to diesel trucks.

The Russians have already signed up to buy a million tons of Cuban sugar next year, but that's not even 20 per cent of the harvest in normal times.

In return for taking all of Cuba's sugar output, the Soviet Bloc would become its sole supplier of manufactured goods.

But Cuba faces a big drawback. The sugar reportedly would be sold for 3.25 cents a pound. Private companies have never been able to get production costs that low. There's doubt that Cuba can either, even with its co-operatives.

Argentina Another

"ARGENTINA has no sympathy for the Fidel Castro regime," says a top official of the Argentine republic.

Alvaro C. Alsogaray, minister of economy and acting minister of labor, made the statement last week at a press conference in Pittsburgh. He is visiting the U. S. as Argentina's representative to the annual meeting of the World Bank.

Comparing the Cuban premier to Hitler, Mussolini, and Peron, Mr. Alsogaray declared: "We know where Cuba is going under Castro. He calls his system 'national socialism,' but the next step is communism. We were close to it ourselves under Peron in 1955. In September of that year, we had a revolution."

• **Tax Incentives**—Argentina is now encouraging foreign investors. "Our investment capital law permits foreign firms to bring equipment and technicians into Argentina and to export profits," Mr. Alsogaray points out. "We are taking steps to insure convertibility, and we're talking about an agreement to prevent double taxation. In general, we tax industry at a 30 per cent rate vs. 52 per cent in the U. S. Foreign based firms are not taxed on the dividends they receive from subsidiaries in Argentina."

Since the 1955 revolution, more than $300 million of foreign capital has been invested in Argentina. U. S. firms that have set up plants in that country include Koppers, Chrysler, Ford, General Motors, Kaiser, J. I. Case, and Cities Service.

Asked about the labor situation, the Argentine official replied:

"Although we have eliminated 65,000 jobs from the bureaucracy, there is almost no unemployment. We have a terrible shortage of skilled people. There have been no political strikes since September, 1959, when the steel and textile workers walked out but failed to win either their political or economic objectives. Under Peron, the unions had great political influence. Today, they're dedicated to the problems of labor instead of politics."

• **Help Wanted**—Argentina is seeking help from the World Bank.

"We need initial help on two big projects, roadbuilding and housing," Mr. Alsogaray explained. "Once we have the equipment we need, we will feel primarily responsible for financing the work through our own savings."

The U. S. should not allow itself to be blackmailed by countries that demand handouts and threaten, if refused, to go to the other side of the Iron Curtain for aid, he added. "The best way is for your government to help . . . those groups (in every country) that are ready to make their own efforts. We don't want to go to Washington and ask for money, so that we can live a little better. We want only assistance, so that we can develop our own resources."

Argentina is apparently licking its inflation problem. The cost of living went up 15 per cent in the second half of 1959 vs. nearly 80 per cent in the first half. It rose only 6 per cent in the first six months of this year and in September dropped slightly—the first time in 15 years.

In June, 1959, the rate of exchange was 110 pesos to the dollar. Today, in a free market, the peso is stabilized at 83 to the dollar. Total reserves of Argentina's central bank have increased from $179 million to $700 million.

"In 1959," Mr. Alsogaray pointed out, "we had a favorable balance of trade for the first time in years —due principally to a new policy in oil. Under state controls, we were never able to produce more than a third of our requirements. By opening our fields to major world producers, we've greatly increased output."

Mr. Alsogaray (left) visited Pittsburgh last week at the invitation of George W. Naylor (right), vice president-general manager of the International Div., Koppers Co., which operates a polystyrene plant near Buenos Aires

Eisenhower's Surplus Shrinks . . . Look for Increased Spending in Fiscal '62 . . . Precheck Your Tariff Appeals

THE FIGURES tell the story: Since President Eisenhower submitted his budget for fiscal 1961 last January, Congress and campaign pressures have forced up federal spending. But increased spending has not been offset by increased federal receipts.

Budget Bureau Director Maurice Stans now expects only a $1.1 billion surplus for fiscal 1961. (Ike wanted $4.2 billion.)

Falling receipts from corporate taxes are the biggest worry of government economists. A drop of $2 billion from the January estimate means receipts will run $21.5 billion—but they will still match those of fiscal 1960. The Budget Bureau thinks individual income tax receipts will hold at the January estimate of $43.7 billion, a $3 billion increase from fiscal 1960.

● PREVIEW OF FISCAL 1962 BUDGET—The current review of the budget provides valuable hints on what metalworking can expect from the President's last budget—it'll be submitted next January for fiscal 1962.

New obligational authority (plans to spend) is on the increase. Increases in the government agencies most important to metalworking include: Atomic Energy Commission, $114 million; National Aeronautics & Space Administration, $113 million; Housing & Home Finance Agency, $524 million; Defense Department (military functions), $648 million; Interior Department, $64 million.

Some of the money will be spent in fiscal 1961, but most of it will be carried over to fiscal 1962 and 1963, providing built-in increases in spending during those years.

● KENNEDY PLANS PUMP PRIMING—The next budget, of course, can be modified by the new President. Vice President Richard Nixon, if elected, can be counted on to hold to the Eisenhower formula. He, no doubt, is in on initial planning.

Sen. John Kennedy (D. Mass.) appears to have significant plans for changing the last Eisenhower budget. The Kennedy advisers, while not yet saying so publicly, fear a slump in 1961 along the lines of the 1958 recession. They would act quickly to bolster defense spending, school construction, depressed area loans, and unemployment compensation.

So the $1.1 billion surplus now envisioned by Ike could easily turn into a $1 billion or so deficit under the Kennedy administration. The senator's economic advisers are also thought to be giving serious consideration to a modest cut in personal income taxes next year to give consumer spending a shot in the arm.

● ADVICE ON TARIFF CASES—Commerce Secretary Frederick Mueller, speaking to a textile group, offered guidelines for appealing to the Tariff Commission under the escape clause of the Trade Agreements Act:

"Instead of presenting the case for multitudinous specific items, it might be more effective to lump together a number of similar products which have been harmed by foreign competition and present a bundle."

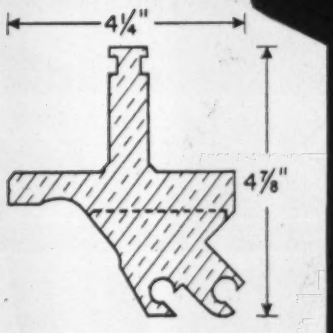
In checking the applicability of the secretary's suggestion to the metalworking industry, STEEL was advised by the Tariff Commission that anyone in doubt about how complaints should be grouped could write the commission, stating that he is contemplating an appeal. He will receive a judgment as to whether different but similar industry appeals could be made jointly. In the past, the Tariff Commission has dealt separately with many product lines, which, on the surface appeared similar.

● RIGHT-TO-WORK DECISIONS AHEAD—The next few months are certain to see significant developments in the right-to-work situation. The National Labor Relations Board will hear oral argument Oct. 27 on the legality of the so-called agency shop arrangement. An agency shop provision in a contract in a right-to-work state requires employees who do not belong to the union to pay what amounts to union dues to the union. General Motors Corp. has been charged by the United Auto Workers with refusing to bargain over an agency shop agreement in Indiana, a right-to-work state. The Indiana Appellate Court has ruled that agency shop agreements are legal. In the past, the NLRB has O.K.'d agency shop agreements as lawful.

In Virginia, the governor has been asked to investigate violations of the state's right-to-work act. A spokesman for the national right-to-work committee claims nonunion people are being refused employment. On the other side, the AFL-CIO claims union members are often refused employment in the state.

● CAPITOL NOTES — High recruitment costs for scientists and engineers are being studied by the House Manpower Utilization Subcommittee . . . The Senate Interior Committee will probably take another long look at the U. S. gold mining industry . . . Over 300 management courses for small business owners will be sponsored by the Small Business Administration in the 1960-61 school year . . . Vitro Minerals Corp., Salt Lake City, has received a federal grant of $37,720 to search Juab County, Utah, for beryllium bearing minerals.

AGAIN-



DOTTED LINE SHOWS where two copper extrusions were brazed together to make original part. When you consider the intricate shape and the weight of the part (a 3¾" section measuring 4¼" x 4⅞", weighing 8 lbs. 7 ozs.), you can readily understand why it was at first thought impractical to make it into a single extrusion.

Revere helps "fit the metal to the job"

AND ONE COPPER EXTRUSION REPLACES TWO, SAVING TIME AND MONEY WITH CONSIDERABLE INCREASE IN LIFE OF PART

The Revere Copper Extrusion shown above was originally two extrusions brazed together. And, since it is quite an intricate shape, and weighty, it was at first thought impractical to make as a single extrusion, but the possibility was believed to be worth investigating.

Through close collaboration between the manufacturer's engineering department and the Revere Methods and Production Departments, it was found possible to combine these two sections into a single extrusion. Work was started, dies were made and test runs conducted. The tooling (for hot extrusion was followed by cold drawing) posed special problems. It had to be both rugged and precise in order to produce this monster to the manufacturer's exacting specifications. Finally, a sample extrusion was delivered to the customer for testing and found to be right in every way.

Not only does this new, single extrusion eliminate a great deal of machining but obviates the necessity of purchasing two separate extrusions and brazing them together. This means substantial savings in dollars and time involved, plus a longer-lasting part, because the heat required to join the two pieces originally used, tended to soften the built-up unit, thus shortening its useful life.

So, before you give up on what at first may seem an insoluble problem, why not call in Revere's Technical Advisory Service? It's entirely possible they can help you "fit the metal to the job" with a resultant saving in the production of a superior product.

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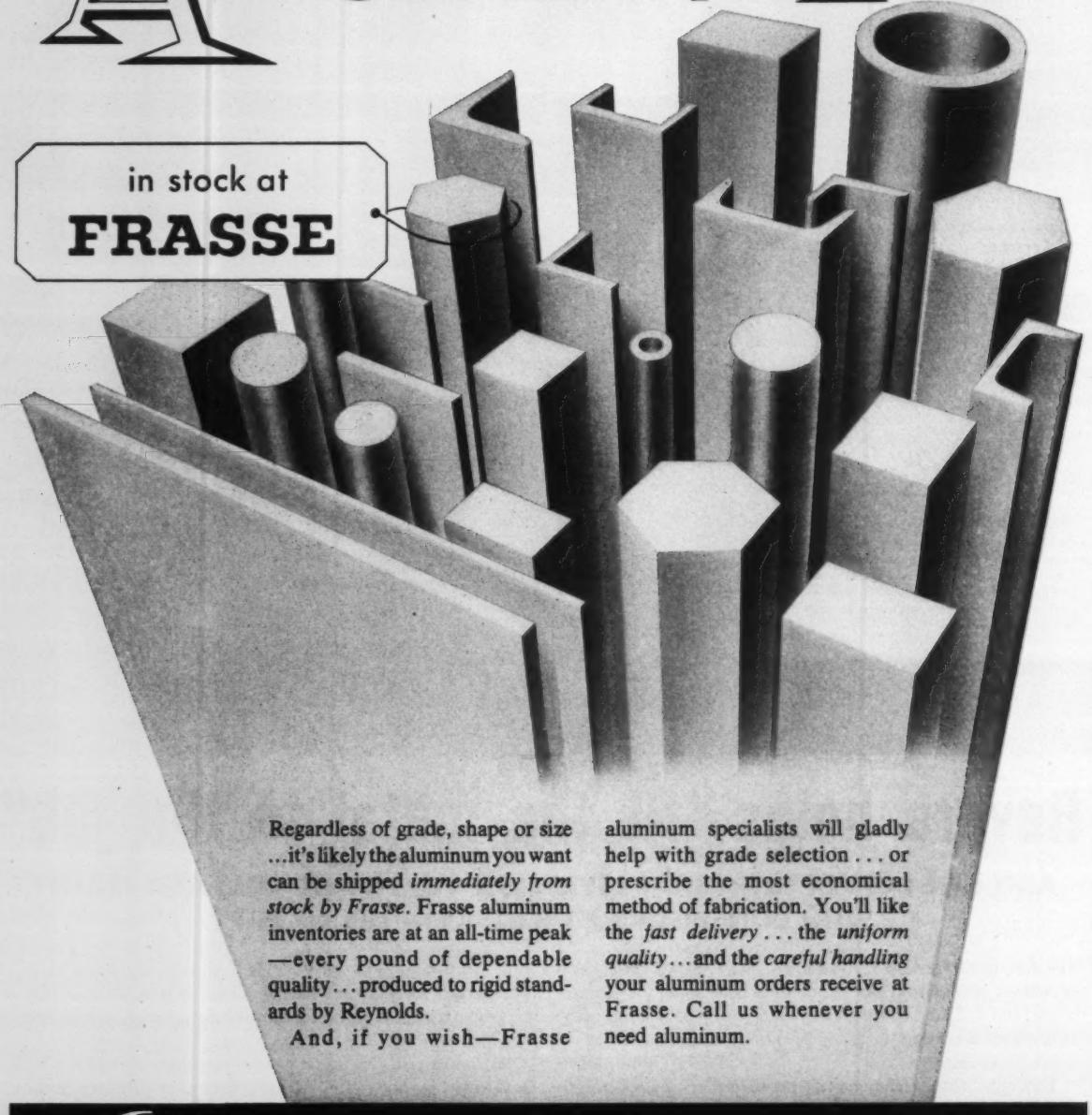

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HURDLE COST BARRIERS WITH...

- **More Standardization**
- **Better Use of Codes**
- **Reform of Restrictive Laws**

THE SUCCESSFUL use of materials can be as complex as a rewarding life with your wife.

Both are arts governed by standards, codes, and laws that are usually helpful, sometimes annoying, and occasionally restrictive. The purpose of this article is to show how standards, codes, and laws can help you toward more efficiency—with materials.

The growing complexity of our economy has accelerated the need for standardization and for means to protect safety and health. So fast has been the pace of our technology that sometimes the safeguards haven't kept up, thus complicating the problem of gaining materials efficiency.

Manmade rules governing the use of materials are a boon to creative buying in the long run because they free you from the burden of having to decide such things as thread size, safe tensile strength, or finish on every purchase.

Let's examine the three general types of regulations:

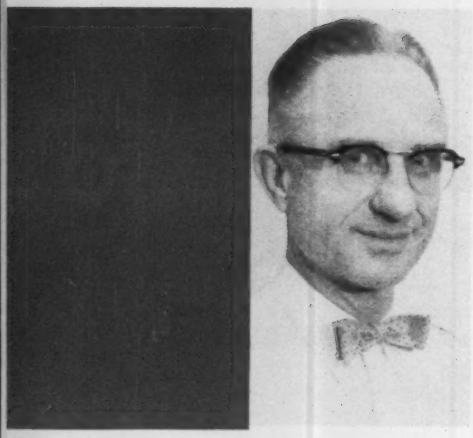
Standards Pay

Standards insure that a fitting fits the pipe, that a lamp screws into a socket, and that the bolt matches the nut. A standard specification spots the exact composition of a grade of steel.

"Civilization cannot exist without standards," says the American Standards Association, New York, the national clearinghouse and coordinating agency for voluntary standards in the U. S. Currently, 1967 American standards exist, affecting practically all sectors of our economy. Many more that haven't been submitted for ASA approval are probably in effect on a company, industry, or area basis.

The U. S. economy could save at least $4 billion a year through standardization, believes ASA. Savings range up to $50 per $1 spent

Why Standardize?



"We standardize because our customers, designers, and other interested parties ask for it," says P. C. Haar, chief standards engineer for Warner & Swasey Co., Cleveland maker of machine tools, textile and construction equipment.

"We're working on standards for the lubricants we recommend because customers want them for the sake of convenience," explains Mr. Haar. "We spent a year reducing the number of sizes in steel bars that we carry because plant personnel wanted it done as a convenience and economy."

A committee studies each standard case at W&S. The group that investigated steel bars consisted of the chief industrial engineer, two design supervisors, the head of the metallurgical department, representatives from production scheduling and purchasing, and the chief standards engineer.

The committee reduced the number of steel bar sizes by more than 10 per cent. The reduction saved engineering time, reduced the space needed for steel storage, cut material handling, lowered the number of orders purchasing had to handle, and allowed the buyers to order in mill instead of warehouse quantities. Another benefit: Up-to-date standard books avoid the delays caused by frequently obsolete vender catalogs.

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on standards work. On the average, $6 is saved for every $1 invested in standards activities.

The mean expenditure on standards by companies that have them is about $25,000 a year—several firms probably budget as much as $1 million annually. One of the best standardized firms is American Telephone & Telegraph Co. The fastener industry is also an excellent example. When self-tapping screws were developed, standardization was almost immediate, points out J. W. McNair, technical director and assistant secretary for ASA.

Specifically, how have standards saved money? Here are cases:

- Norton Co., Worcester, Mass., saved $3700 per year by standardizing on ball bearings.
- Signode Steel Strapping Co., Chicago, standardized on its packaging equipment and boosted production by 9 per cent.
- General Electric Co. can save 15 per cent annually through its general standardization program.
- An aluminum producer has reduced the number of carbon brushes it buys from 9000 to 734 through standardization.
- Engineers at two of Rockwell Mfg. Co.'s power tool divisions whittled a list of 123 different types and sizes of nuts down to 54. Of the 54, only half kept their original specifications. The saving was at least $5000 a year.

Your losses may be substantial, although partly hidden, if you don't purchase standard parts wherever possible. "I'm dismayed by the number of specials demanded where standards would do the job as well," says Edward D. Clark, standards engineer for Standard Pressed Steel Co., Jenkintown, Pa.

Examples:

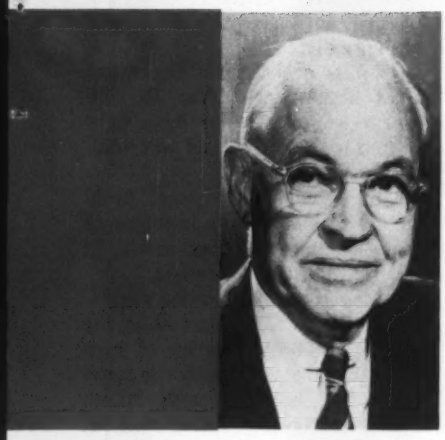
- A customer ordered 5/16-24 x $1\frac{1}{4}$ in. cap screws. He wanted them shorter than standard thread length. He could have used the standard. It cost $257 extra to set up the job.
- A customer ordered 720 pieces of 8-32 x $\frac{5}{8}$ in. SHCS, stainless steel. He ordered a different type of austenitic stainless than SPS was running as standard. If he had just specified "austenitic stainless," it most likely would have served his purpose. The standard cost would have been $64, but SPS had to charge $151 because of the extra machining.

If an order comes to the company for slightly off-standard products, SPS gives the customer two quotations—one for the standard product that most nearly resembles the customer's needs and another exactly in accordance with the customer's stated requirements. That permits the customer to see exactly how much he is paying for a special and indirectly encourages him to buy a standard fastener.

Adds Mr. Clark: "Too many companies let the draftsman make a decision for a special that will triple their fastener costs."

Standardization also pays off for makers of products that undergo

Why Check Code Requirements?



Codes often create expensive fastening problems . . . for the manufacturer or customer, says John S. Davey, sales vice president for Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

RB&W engineers found an air conditioning manufacturer was not tightening bolts on compressors to the 60 per cent of ultimate tensile strength that good practice indicates. Reason: The American Society of Mechanical Engineers' Code for Unfired Pressure Vessels stated that maximum bolt stress on equipment used in the −20 to +400° F range should not exceed 20 per cent of the ultimate tensile strength of the bolt material. Significance: Where a Grade 5 bolt with an ultimate tensile strength of 120,000 psi was being used, it was being torqued to only 24,000 psi.

An ASME inspector was consulted. Because the operating range of the equipment was from room temperature to not more than 115° F, he decided it would be allowable to stress the bolts to the 60 per cent level (72,000 psi) if RB&W certified that minimum tensile strength was above 120,000 psi. That was no problem. With the higher stress allowed, it was possible to reduce the number of bolts used or the size—in either case, saving on fastening.

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periodic model changes. Moto-Mower Inc., Richmond, Ind., a subsidiary of Dura Corp., makes as many parts as possible that are interchangeable with older model mowers. The strategy cuts down on replacement inventories.

Another approach to standardization that pays off big: If you have several customers ordering specials which are similar, try to get all of them to use the same special. It then becomes almost a standard, lowering your production costs and the price you can charge.

Redesign can bring standardization benefits too. Westinghouse Electric Corp. has redesigned all horizontal squirrel cage, wound rotor, and synchronous motors from 250 to 7000 hp to use only five basic enclosures. Six basic frame sizes are made for each of the enclosures, or a total of 30. That compares with 450 frame sizes formerly used.

Of course, not everybody likes standards. Makers of special machine tools agreed with great reluctance to go along with automakers and other large customers who asked for standard dimensions on some sections of equipment.

"We went along," says one builder, "because of the implied threat that if we didn't we'd lose the business. It galls me that they should dictate to us."

And others think some standards are wrong. Standards often call for cast pipe plugs. Sam Katz, owner-president of Pipe Plugs Inc., Wellington, Ohio, supplies them. But he also makes cold headed plugs and believes they are superior and can be produced at less cost.

Yet the principle of standards is generally accepted, and most companies want more. Carbone Corp., Boonton, N. J., maker of carbon brushes, says: "There is still room in our industry for considerably more standardization."

A pipe manufacturer comments: "The problem of standardizing plastic pipe and tubing poses additional work for the future."

Stone & Webster Engineering Corp., New York, says: "We are far from achieving the ideal" in the mechanical-electrical industry.

Comment on Codes

Of all the regulations affecting the use of materials, codes have been criticized as the most restrictive. Most of the fault has been found in building codes. They outnumber similar regulations in such areas as bridges and pressure vessels.

But the situation is improving markedly. Says the American Iron & Steel Institute: "Progress in modernizing municipal building standards and obtaining greater uniformity among the building codes of all municipalities has been registered over a wide front."

As recently as ten years ago, nearly half of the 2200 city building codes were 15 years old or older. A substantial majority of the ob-

solete ones have been modernized since.

Codes have been assailed as contributing to higher building costs. "But inflation outweighs the influence of building codes on costs," says the U. S. Chamber of Commerce.

Some criticize codes for the variations among cities. That problem has been relieved by the standardization by 75 to 80 per cent of the municipalities on four model building codes in the U. S. All four are performance rather than specification codes. Performance regulations set up criteria that permit any material to be used if it meets the requirements. Specification codes usually call for a particular material and are less liberal.

The work of some local code writing committees has also been attacked. But widespread use of the four models has relieved the difficulty. The models have been set by the National Board of Fire Underwriters, Chicago; Building Officials Conference of America Inc., Chicago; International Conference of Building Officials, Los Angeles; and Southern Building Code Congress, Atlanta.

Many companies handle code problems in two broad ways:

1. They deal with special problems on a spot basis.

One maker of prefabricated homes goes to the municipality to argue for change. "We pick our spots," he says. "We have a better chance for change in a city with performance codes, so we concentrate in those municipalities." Sometimes, in the case of a one shot proposition, it's wise to try for a single exception for a building without the trouble of changing codes.

2. Companies troubled by codes also work through associations, such as the American Institute of Steel Construction or the American Iron & Steel Institute.

Here are examples of successful code changes cited by AISI:

• Plastic Design—Plastic design of steel structures makes use of the fact that structural steel is highly ductile; that ductility represents a reserve of strength largely disregarded in the elastic design method commonly employed. On the average, the main frame of a plastically designed structure weighs 15 to 20 per cent less than one designed via the older method. Such savings do not cut the safety factor. Plastic design can also save time in the structural design.

• Curtain Walls—More than 80 per cent of the building codes in U. S. cities having a population of 100,000 or more now permit curtain wall construction or have such code amendments under consideration.

• Increased Floor Areas — Codes have been relaxed, and building costs have been reduced as a consequence.

Suggestions for code changes or exceptions are usually submitted to the building commissioner. He can often O.K. exceptions. He'll evaluate code proposals, then refer them to a board of review for approval. Public hearings follow. If no objections are made, the proposals then go to the city's legislative body. The whole code changing process takes about three years, on the average.

What the Law Allows

State and local laws sometimes block the most efficient use of materials. For instance:

• Certain health departments have required a higher finish or other small difference in stainless steel used in dairy equipment. Such requirements slow down the acceptance of the most modern equipment. Allegheny County and Ardmore, Pa., had such restrictive rulings. As a result, stainless producers, the U. S. Public Health Service, and dairy equipment makers started a research program at Michigan State University. Its findings were believed instrumental in persuading Allegheny County to back down part way. But not Ardmore. The cost of equipment with special finishes runs 20 to 40 per cent higher than for standard finishes.

• A 1959 amendment of the milk sanitation laws takes the regulation of milk from Pennsylvania's Health Department to the secretary of agriculture. Canned milk is singled out. The office of the secretary can approve or disapprove the processing and the pack for milk. It's a precedent that could be extended to food packs.

The Pennsylvania action is believed related to the research and progress in canning fresh tasting milk. Three institutions (Universities of Wisconsin and Illinois and Michigan State) have a project going which might disrupt local producing and distribution patterns. The milk problem is still only a threat because the new canned milk is not yet on the market, but it will be eventually.

A similar packaging difficulty occurred after World War II with paper containers. The legal fight went on for ten years and was finally won.

A different kind of legal problem may hinder the acceptance of fallout shelters. By extension, it hinders the use of materials.

Internal Revenue Service regulations, for instance, do not allow the writing off of the expense of such shelters against income. Some states re-evaluate buildings with fallout shelters and boost property taxes accordingly.

What's more, some building codes do not provide for shelters, although that is being remedied. A unit developed by Wonder Building Corp. of America, Chicago, has been hailed by Leo A. Hoegh, national civil defense director, but it doesn't conform to the Chicago code.

Slow Solutions

When you're dealing with standards, codes, and laws, reforms seldom come overnight. But they do come—if you work patiently for them.

And when such regulations are reformed, they can be the basis for the successful use of materials.

Materials Efficiency

Teamwork Trims Costs

That's the article coming up Oct. 24 in STEEL's 1960 Management series. For a free copy of any or all the articles in this 13 part program on materials efficiency (which started July 4 and runs every other week), write Editorial Service, STEEL, Penton Bldg., Cleveland 13, Ohio. Also available on the same basis is the companion series on production efficiency which appeared during the first half. Use of material like this may win you $1000. For details, see Pages 5 and 6.

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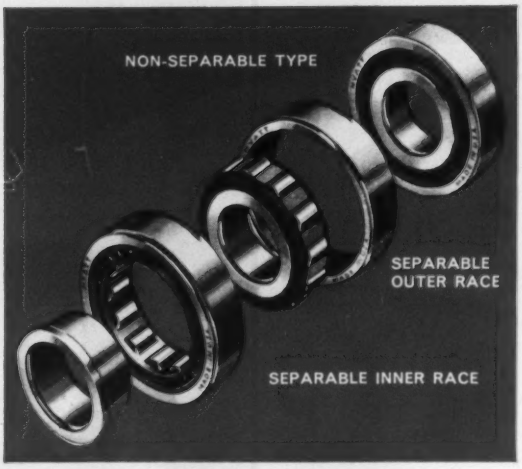

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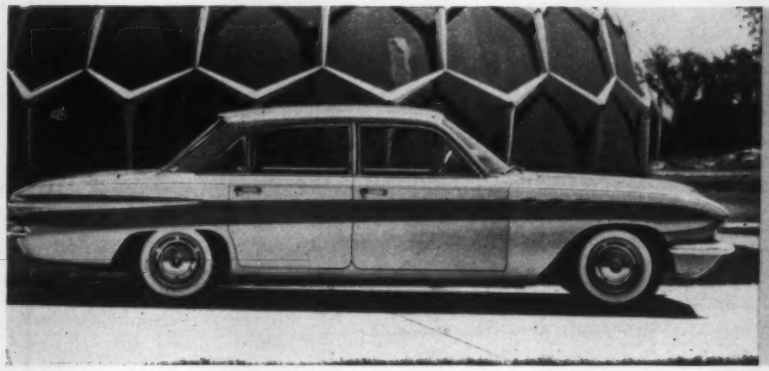

Buick's Special

188 in. long, 155 hp

$2,175

Market Role of Compacts Changes

DETROIT'S marketers are refining their definition of the compact car buyer.

Originally, they assumed they were catering exclusively to bargain hunters who wanted stripped down, economy cars. Now they're finding that a lot of these people are willing to pay extra for additional performance, power assists, and interior accessories that help make driving less a chore. It's estimated that more than 60 per cent of the U. S. built compacts sold this year will sport optional items.

Automakers are pleased because the sale of accessories will help boost the low profit margins on compacts. It also means that many of the medium price divisions can now offer a car which will help bolster their sagging price group. Chase Morsey Jr., Lincoln-Mercury's general marketing manager, says the traditional medium price group has plummeted from 40 per cent of all sales in 1955 to 19.5 per cent in the first half of this year.

• **Changing Times**—Demand for "costlier" compacts is only part of the story of a changing buying public. To keep up, autodom will take two approaches to car marketing in 1961.

Ford Motor Co. will be emphasizing function, size, value. Each of its dealers will offer cars in a variety of price and size ranges. It's the same concept American Motors Corp. and (to a limited extent) Studebaker-Packard Corp. have been following.

General Motors Corp. still seems to be sticking with the more traditional low, medium, and high priced group approach, with compacts inserted into these classes. Partly because of corporate structure, GM dealers will be limited in the sizes and classes of cars they can offer. Chrysler Corp. is patterning its marketing strategy along the same lines.

Although those shifts may seem slight, they could have far-reaching effects. Metalworking should study the changing market closely because it will help pinpoint product changes that will influence suppliers of parts and materials.

Ford's Size-Value Concept

Ford Motor Co.'s approach rests on three basic points:

1. Buyers have become better educated and are more realistic about car buying than the industry has realized or cared to admit.

2. The uses to which a car will be put and the size of car needed to do those jobs are more important than cost.

3. Each division and dealer should be provided with at least four different sizes of cars to meet the dif-

U. S. Auto Output

Passenger Only	1960	1959
January	688,731	545,756
February	659,323	478,518
March	654,242	576,080
April	582,909	578,846
May	611,226	546,817
June	613,147	557,995
July	434,377	555,410
August	305,527	239,152
September	408,400†	258,151
9 Mo. Totals	4,957,882†	4,336,725
October		507,527
November		254,527
December		494,931
Total		5,593,707

Week Ended	1960	1959
Sept. 3	51,647	17,261
Sept. 10	52,635	24,364
Sept. 17	85,879	62,716
Sept. 24	120,722	91,341
Oct. 1	137,023†	105,720
Oct. 8	140,000*	118,793

Source: *Ward's Automotive Reports.* †Preliminary. *Estimated by STEEL.

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ferent needs of buyers.

• **Smart Buyers**—People are getting more sophisticated every day, declares Mr. Morsey. He cites: More people attend classical concerts than baseball games. Between 35 million and 40 million people are enrolled in adult education courses. More than 650 million books were sold in the country last year—double the number a decade ago. There will be 200 per cent more college students in 1970 than there were in 1950. More than half the people in the country do the bulk of their shopping after 5 p.m. Every day, some 90,000 people change residences.

Asserts James O. Wright, Ford Div.'s general manager: "We need to be absolutely realistic in facing the facts that are presented to us and in accepting their implications fully whether they happen to fit in with our preconceptions and our desires."

• **Segmented Market** — "The consumer revolution is not so much a demand for lower prices or greater economy, but rather a demand for the value (the consumer) expects of a car. The old low and medium price fields which were common to the industry for years are now divided into size segments such as small foreign cars, domestic compact cars, conventionally sized cars, and luxury cars," says Walker Williams, Lincoln-Mercury's assistant general manager.

• **Model Spread**—Lincoln-Mercury, for example, will offer the imported Anglia for utility transportation. Comet meets the needs of buyers who want more economy of operations but can afford more than an austerity car. Mercury is built on the Ford body shell and comes in two lines from almost the bottom of the old low price field into the former medium price field. A smaller Lincoln Continental remains as the single luxury car offering. Lincoln-Mercury will no longer import the Taunus. Ben Mills, division vice president, says it will take six months to sell the 1000 models in inventory.

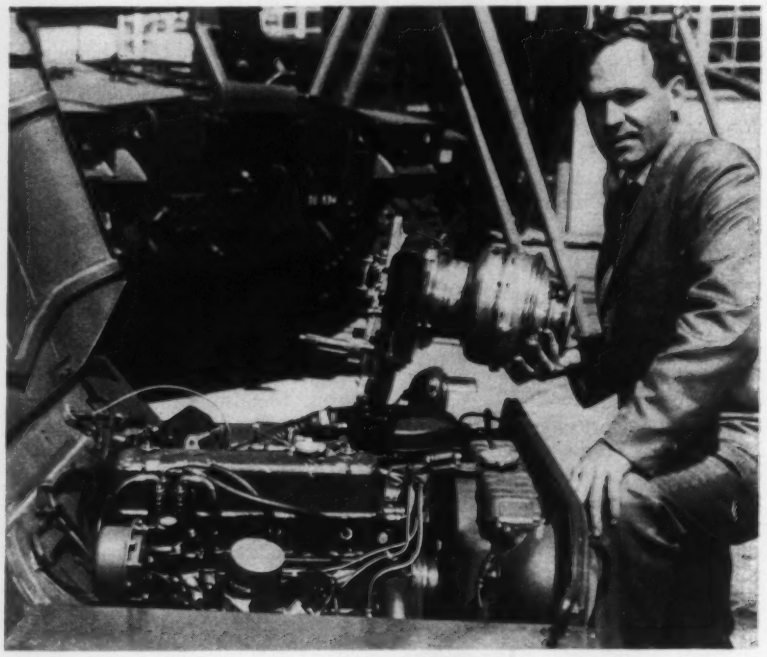
Ford Div. has a similar product spread for its dealers, with Thunderbird filling the higher priced slot. Although the division does not have a utility car, Mr. Wright says that if the import market remains around half a million units annually, it probably will be worthwhile to get into this market. The small Cardinal can be brought to market quickly judging from vender reports on tooling status.

GM's Price-Namebrand Approach

Oldsmobile and Buick are the best examples of GM's more conventional marketing approach. Both the F-85 and the Buick special compacts will be marketed as junior editions of the regular car lines. Both are priced higher than the limits of this year's compact field and higher than many of the standard cars. The four door sedans list for $2175. Plymouth's Savoy is listed at $2106, Chevrolet's Biscayne at $2106. Jack F. Wolfram and Edward D. Rollert, general managers of Olds and Buick, are quick to point out that these standard sized cars have six cylinder engines. Their compacts have higher performing 155 hp aluminum V-8's.

Pontiac Div. is taking a slightly different tack. Semon E. Knudsen, general manager, says his smaller Tempest (built on the same body shell as the other two compacts) will "release dealers from the restraining anchor of the medium price class." It also appears that the lower priced ($1975), slightly lower powered compact will not be identified quite so closely with its medium priced sister. With its unique engineering developments (a four cylinder engine, whipshaft, and transaxle), the Tempest should also have special sales appeal for the mechanically minded buyer.

With Corvair's extended line of truck and pickup type compacts, GM can now offer each of its low and medium price divisions a smaller car. But because of division autonomy, dealers of medium price cars will sell medium price compacts. Dealers in the lower price bracket will sell the less expensive compacts. Most of them will attempt to build sales on divisional brandnames. Economy will be talked of in terms of improved performance and greater reliability.



NEW LIGHTWEIGHT GAS TURBINE, developed by Williams Research Corp., Walled Lake, Mich., is held by Sam Williams, company president. Note how much smaller it is than the Jeep engine, which it will replace in tests. Williams was awarded the testing contract by the Detroit Ordnance District under the technical supervision of Ordnance Tank Automotive Command, Detroit

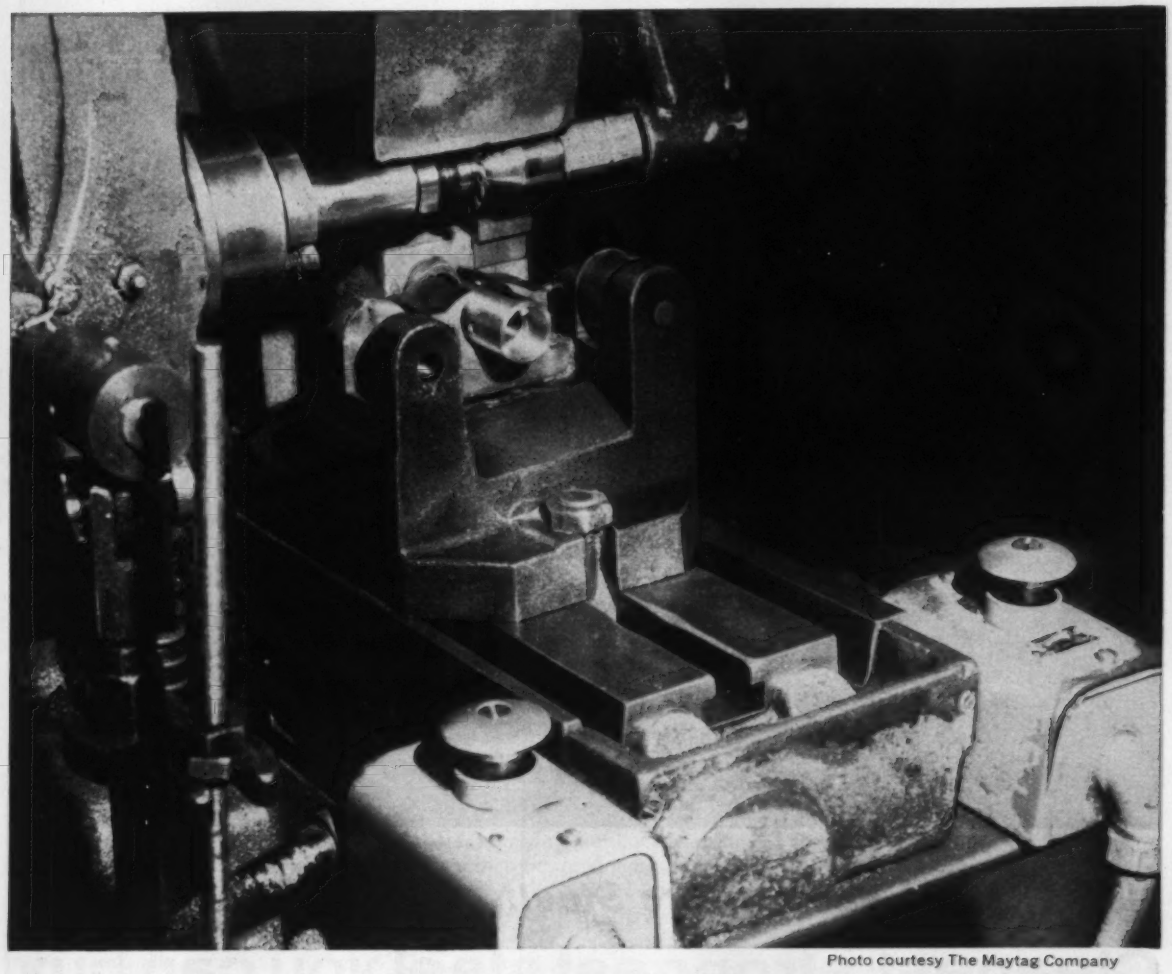


Photo courtesy The Maytag Company

Aristoloy Leaded 8620 cuts tool changes 50% on wringer drive sleeve for Maytag

Has working time been reduced? Yes.

In what way? The use of Aristoloy Leaded* has increased tool life and reduced downtime for tool changes.

Has machining been improved? Yes.

What inherent quality in the steel is responsible for improved machining? A more uniform, satisfactory microstructure provides better machining characteristics.

What operation is performed? Automatic screw machines bore, counterbore and cut off. Secondary operations include milling, drilling, internal and external grinding after carburizing.

For complete information about Aristoloy blooms, slabs, billets and bars, in carbon, alloy, stainless and leaded, call the Copperweld representative in your nearest large city—or write for NEW PRODUCTS & FACILITIES CATALOG.

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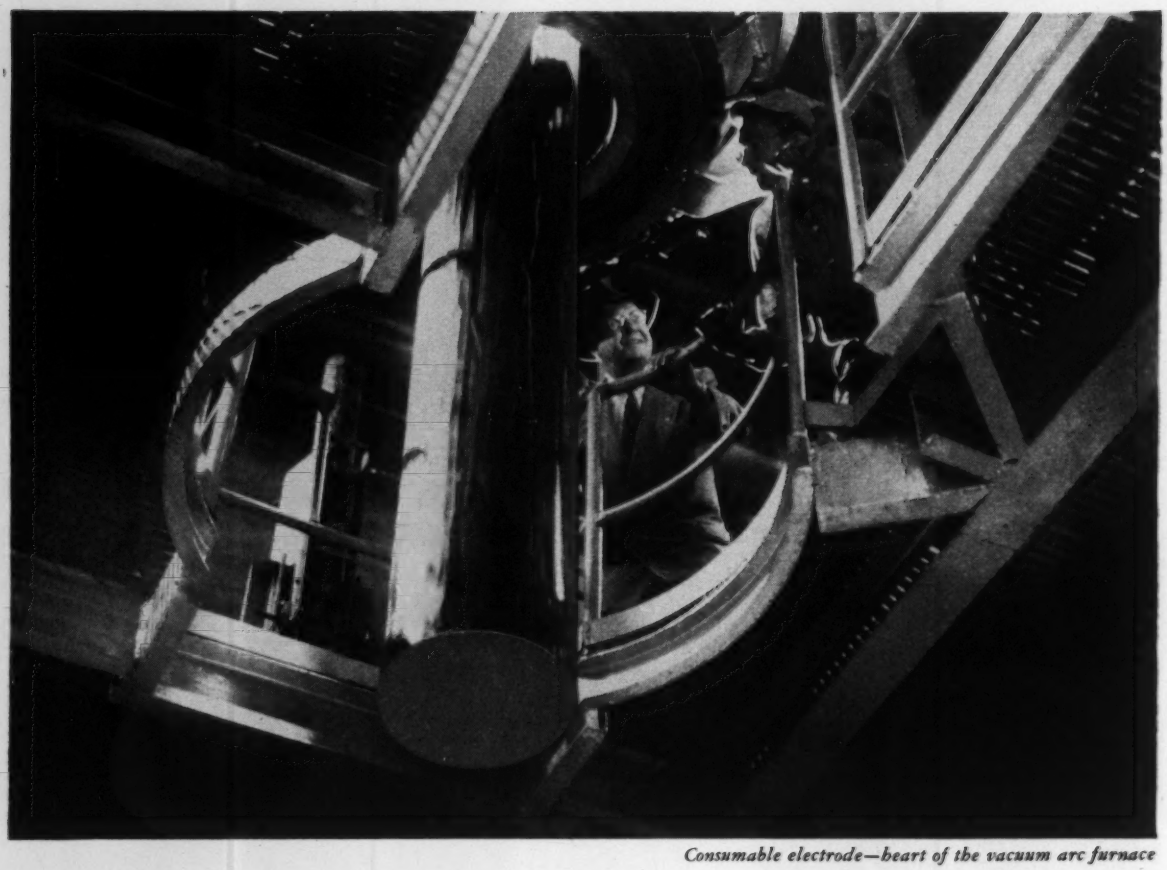

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IF you make or plan to make parts that must have exceptionally clean and strong steel, specify Timken® steel made by the vacuum arc process. It's ideal for aircraft, jet engine and other parts where such steel is vital. Timken vacuum arc process steel is the cleanest steel available in commercial quantities. And only the Timken Company furnishes this super-clean steel in bars, wire, and rotary-pierced tubing in a wide range of alloy and stainless analyses.

You get these advantages:

SUPERIOR CLEANLINESS. The melting process eliminates contamination from three basic sources—air, slag and crucible. Furthermore, gaseous impurities in the electrode metal are drawn out by the vacuum during melting.

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These two factors—superior cleanliness and better dispersion—result in a more uniform steel of very high strength and ductility. ***When you buy Timken steel you get:*** *. . . 1) Quality that's uniform from heat to heat, bar to bar, order to order. 2) Service from the experts in specialty steels. 3) Over 40 years experience in solving tough steel problems* For further information, write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

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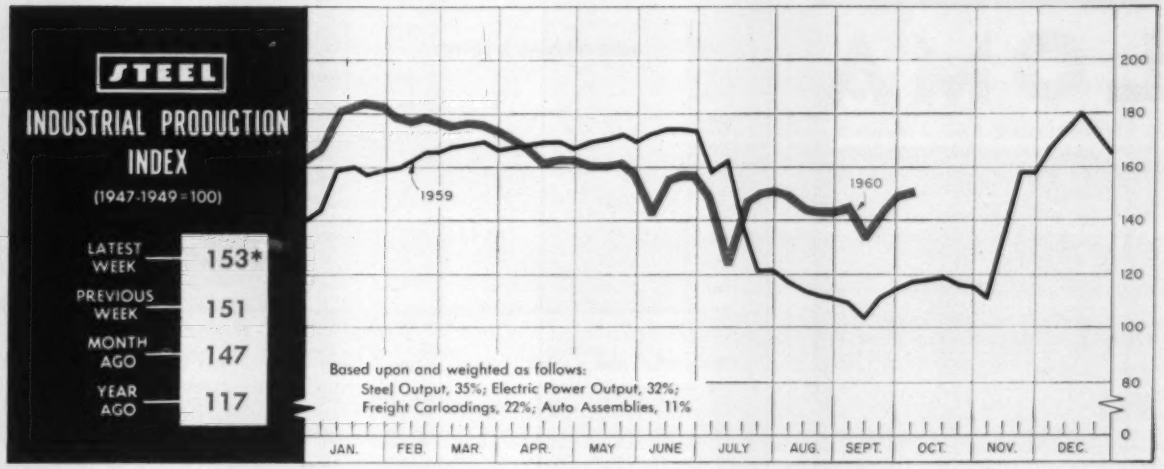


*Week ended Oct. 1.

October May Tip Economic Balance

A GLANCE at STEEL's industrial production trend line above would almost be enough to make confirmed optimists out of the biggest bears. The index has advanced steadily since the Labor Day week, reaching the year's high point of 154 (preliminary estimate, 1947-49 = 100) during the week ended Oct. 1. Not since the last week in July has it been that high.

But upon closer analysis of the index, it becomes clear that things aren't what they should be for this time of the year. The gain of 6 points since the week preceding the Labor Day holiday is accounted for almost entirely by the automotive industry. In fact, a 10 point gain in this segment has been partially canceled by a seasonal drop in power production, while steel output and railroad freight carloadings have shown little, if any, movement.

• **Misleading**—The early introduction of 1961 models has thrown some economic indicators out of kilter this year. As pointed out in this column on Sept. 26 (pp. 83-85), the direction of STEEL's production trend line during September usually presages the economy's general direction throughout the fourth quarter. However, in most years, any September movement could be attributed to general strengthening in several segments of the economy because the big push from motordom did not show up until October. If last month had been a "normal" automotive month, the trend line would have been almost flat.

The immediate outlook depends on whether car production is maintained at a high level throughout October. If it is, it may stimulate other businesses and bring about some upward movement in the economy. If auto production slumps, you can expect further weakness in steelmaking and many supplying industries, which could be enough to drop economic activity another notch.

• **Beyond the Index**—The economy

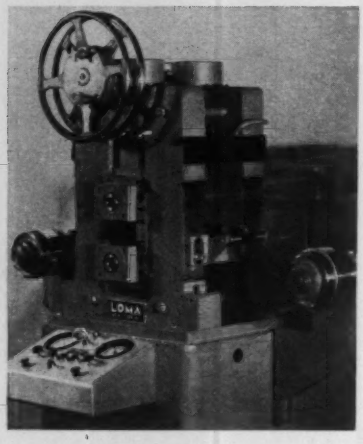
BAROMETERS OF BUSINESS

	LATEST PERIOD*	PRIOR WEEK	YEAR AGO
INDUSTRY			
Steel Ingot Production (1000 net tons)[2]	1,500[1]	1,558	362
Electric Power Distributed (million kw-hr)	14,100[1]	14,156	13,234
Bituminous Coal Output (1000 tons)	8,100[1]	8,130	7,809
Crude Oil Production (daily avg—1000 bbl)	6,850[1]	6,877	6,825
Construction Volume (*ENR*—millions)	$409.5	$368.4	$409.6
Auto, Truck Output, U. S., Canada (*Ward's*)	162,860[1]	145,455	132,945
TRADE			
Freight Carloadings (1000 Cars)	620[1]	618	573
Intercity Truck Tonnage (changes from year ago)	−2.1%	−1.1%	+7.5%
Business Failures (Dun & Bradstreet)	321	305	282
Currency in Circulation (millions)[3]	$32,004	$32,171	$31,811
Dept. Store Sales (changes from year ago)[3]	+2%	−5%	+7%
FINANCE			
Bank Clearings (Dun & Bradstreet, millions)	$27,566	$31,496	$22,118
Federal Gross Debt (billions)	$288.9	$288.5	$228.7
Bond Volume, NYSE (millions)	$28.1	$23.4	$31.4
Stocks Sales, NYSE (thousands of shares)	16,853	14,930	13,639
Loans and Investments (billions)[4]	$106.8	$105.5	$103.4
U. S. Govt. Obligations Held (billions)[4]	$28.0	$27.5	$28.4
PRICES			
STEEL's Finished Steel Price Index[5]	247.82	247.82	247.82
STEEL's Nonferrous Metal Price Index[6]	226.4	230.1	225.5
All Commodities[7]	119.5	119.4	119.2
Commodities Other than Farm & Foods[7]	128.2	128.2	128.4

*Dates on request. [1]Preliminary. [2]Weekly capacities, net tons: 1960, 2,849,308; 1959, 2,831,846. [3]Federal Reserve Board. [4]Member banks, Federal Reserve System. [5]1935-39=100. [6]1936-39=100. [7]Bureau of Labor Statistics Index, 1947-49=100.

NEWS FROM

LOMA



This rugged and versatile reversing 2-high / 4-high combination mill brings high-precision rolling of thin-gauge ferrous and non-ferrous strip within reach of the smaller re-rolling mill, metals pilot plant and research laboratory. Occupying only 35 sq. ft. of floor space and involving a cost of less than $20,000, the machine handles up to 6 in. wide strip at rolling speeds up to 250 ft. per min. with accurate front and back tension control.

The new 8 in. mill is furnished with two sizes of 4-high work rolls, made of either alloy tool steel or solid tungsten carbide: the 1½ in. size is used for normal cold reduction down to 0.002 in. thickness, and the ¾ in. size allows special ultra-thin finishing to gauges of less than 0.001 in. In the 4-high setup, the machine handles up to ⅛ in. gauge; the 2-high arrangement is used for the hot or cold breakdown of heavier materials up to 1 in. thick, but is also available for skin pass rolling of thin strip.

The production of close-tolerance stock is assured by an exceptionally rugged mill design, employing steel housings of 160 sq. in. post area, super-precision needle roller journal bearings of 175,000 lb. separating force capacity, a heavy-duty mill drive with herringbone gearing and universal joint spindles, and twin-handwheel worm drive screwdowns. The machine is powered by a four-speed reversing drive offering constant horsepower from 40 to 250 ft. per min. rolling speed.

The outstanding feature of the new machine is its reversing strip coiling attachment allowing the two-way rolling of strip under tension control with no more effort than a mere flick of a selector switch. Mounted on brackets at either side of the mill, the two coiling shafts carry 8 in. diameter reels designed for a coil buildup of 6 in. Both shafts are driven from the pinion stand and are provided with dual air-operated slip clutches and brakes of ultra-sensitive, low-inertia design. Selective operation through solenoid valves and pressure regulators precisely controls the front and back tensions desired for any given mill pass.

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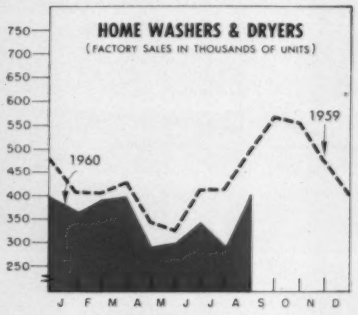
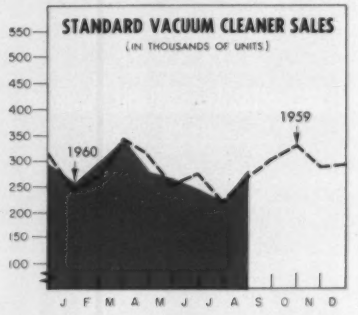
THE BUSINESS TREND



	Washers		Dryers	
	1960	1959	1960	1959
Jan.	254,565	288,491	111,603	118,220
Feb.	283,640	297,826	108,367	106,274
Mar.	305,635	329,668	90,205	98,434
Apr.	235,828	274,372	53,213	67,752
May	243,943	277,934	53,700	45,903
June	276,955	341,894	64,950	70,838
July	217,655	318,063	72,580	95,248
Aug.	296,499	359,849	105,119	133,197
Sept.	.....	394,112	.....	174,560
Oct.	.....	374,135	.....	179,669
Nov.	.....	312,796	.....	157,047
Dec.	.....	264,236	.....	134,633
Totals	.....	3,833,376	.....	1,381,775

American Home Laundry Mfrs. Assn.



	1960	1959	1958
Jan.	258,330	242,516	265,489
Feb.	294,483	271,396	225,631
Mar.	339,918	346,557	291,418
Apr.	278,391	317,402	247,293
May	265,556	257,345	218,766
June	245,790	275,974	253,127
July	223,008	221,232	263,778
Aug.	280,575	268,465	280,226
Sept.	.....	305,096	299,618
Oct.	.....	330,899	339,127
Nov.	.....	290,130	293,609
Dec.	.....	293,818	316,965
Totals ...	.....	3,420,830	3,295,047

Vacuum Cleaners Mfrs. Assn.

Charts copyright, 1960, STEEL.

is now in a delicate balance. Production of durable goods is weak. But strength in nondurables and services is holding off the decline predicted last week by STEEL's Panel of Economic Consultants (see Oct. 3, pp. 39-41). Unfortunately, the panelists have history and a lot of facts on their side.

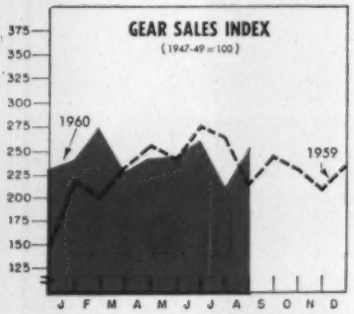
Since World War II, every time the production of durable goods has taken a nose dive, the rest of the economy has followed sooner or later. A look at about 35 statistical series on orders and shipments of durables (tabulated by STEEL and presented periodically in the four graphs above) leaves little doubt that this sector is, and has been for some time, weaker than the over-all figures would lead you to believe.

• **Scoreboard**—In the latest month for which reliable figures are available (July or August), 20 of the indicators were down from the month-ago levels, and 24 were below the corresponding 1959 levels. Only 14 were up month to month and 11 year to year. But the telling fact is that the longer term trend for 21 of the indicators has been down, while only eight have shown any real uptrend. The others have shown erratic patterns.

• **Cumulative vs. Rolling**—The argument is now shaping up as to whether we are entering a cumulative recession—similar to the other three post-World War II recessions, or whether we will have a true rolling adjustment in which the ups and the downs balance out, leaving the total economy on a plateau.

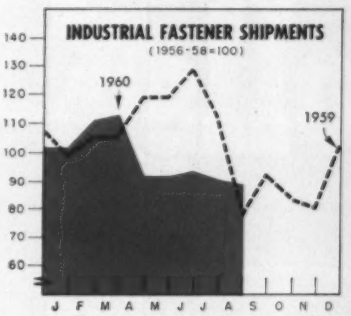
• **The Levelers**—Those who see a rolling adjustment point out that there has been relatively little movement in the Federal Reserve Board's industrial production index since the peak was reached last January, despite a 5 per cent drop in the durable goods index. At the same time, gross national product, national income, and total employment have remained at record levels. They also point to fluctuations within industries which tend to cancel each other — typical of rolling adjustments.

For instance, in appliances, latest information has gas range sales up, electrics down; refrigerators down, water heaters up; radio and television sets down, vacuum cleaners and home laundry equipment up (see graphs above). Among components usually thought of as being bellwethers, gear sales are up, but fasteners are down (see graphs



	Bookings		Shipments	
	1960	1959	1960	1959
Jan.	243.4	218.6	207.3	187.7
Feb.	278.6	199.9	230.2	201.5
Mar.	231.8	234.3	244.6	222.7
Apr.	249.2	255.6	234.8	231.8
May	246.9	241.0	241.3	223.9
June	269.8	274.2	253.6	239.7
July	217.5	262.8	210.8	199.8
Aug.	255.8	213.3	217.3	204.3
Sept.	....	213.9	....	216.1
Oct.	....	230.5	....	224.1
Nov.	....	208.7	....	224.2
Dec.	....	233.9	....	250.2
Avg	....	234.7	....	218.8

American Gear Mfrs. Assn.



	(Seasonally adjusted)			
	1960	1959	1958*	1957*
Jan.	102	99	133	173
Feb.	111	105	117	177
Mar.	103	105	103	166
Apr.	92	119	102	157
May	92	119	111	168
June	94	129	120	162
July	91	112	133	184
Aug.	89	77	120	155
Sept.	....	92	141	159
Oct.	....	83	137	163
Nov.	....	80	134	147
Dec.	....	102	152	140
Avg	....	101	125	162

*1947-49=100.
Industrial Fasteners Institute.

above). In capital goods, foundry equipment orders are up, material handling bookings down.

• **The Recessionists**—Those who see a minor recession point to a general lessening in consumer confidence. Retail sales have been sagging of late, and department store sales have been in the minus column more than the plus since late summer. They also note that in the August production report of the Federal Reserve Board, it was difficult to find any plus signs. In addition, the increase in total personal income in August was only $300 million (sesonally adjusted) ahead of the July figures, with all the increase coming from other than wage and salary disbursements. If it hadn't been for the increase in the wages of government workers, that segment would have shown a decline. (But as one wag put it: "Don't knock 'em. They're consumers too.") Suffice it to say that the government, with its pay increases and a $400 million increase in transfer payments, kept total income from showing the first decline since August, 1959—during the steel strike.

The recessionists liken the current situation to that of the early part of 1957, when "rolling adjustment at a high plateau" became a popular phrase—only to give way eventually to "inventory readjustment" and finally "recession."

• **Too Early**—It still is probably too early to conclude whether the economy is or is not heading into a recession. Perhaps the signs will be clearer by the end of October.

Trends Fore and Aft

• Kaiser Aluminum & Chemical Co. laid off 200 workers earlier this month at its Chalmette, La., reduction plant. In Dayton, Ohio, Frigidaire Div. of General Motors Corp. planned to recall 350 workers to help build up 1961 model appliance production, then decided to boost the figure to 525.

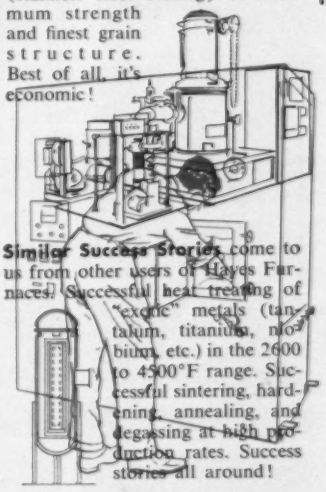
• Heavy construction contracts set a September record with a total of $2.2 billion, says *Engineering News-Record*. The cumulative total is now 10 per cent ahead of the corresponding 1959 figure.

• "The usual fall push is not there," states the Purchasing Agents Association of Cleveland in its September report. Production rose following Labor Day, but new orders stayed at the August level.

HERBERT W. WESTEREN, Assistant Director of Hayes Research and Development Group, tells about the . . .

"VACUUM AGE" OF HEAT TREATING

A major New York manufacturer of aircraft equipment recently reported their Hayes Vacu-Master Cold Wall Furnace was paying off in many ways — providing rapid cycling, simplified work handling, and complete production flexibility. Additionally, the vacuum furnace has eliminated need for atmosphere equipment . . . and produced work (stainless steel brazing) of maximum strength and finest grain structure. Best of all, it's economic!



Similar Success Stories come to us from other users of Hayes Furnaces. Successful heat treating of "exotic" metals (tantalum, titanium, niobium, etc.) in the 2600 to 4500°F range. Successful sintering, hardening, annealing, and degassing at high production rates. Success stories all around!

The "Universal Atmosphere" has Universal Applications

Unlike "atmospheres," vacuum has virtually no job limitations. Here's where the ingenuity of Hayes engineers comes into play. By coordinating advanced design with job requirements . . . and PROVING RESULTS in their own lab . . . Hayes vacuum furnace engineers assure the customer "RESULTS GUARANTEED" every time. I'd like to invite you to advance your heating in practice . . . with HAYES. Write for vacuum Bulletin 5709A.

See first showing new console vacuum furnace Booth 1454 ASM Show

C. I. HAYES, INC.

Established 1905

839 WELLINGTON AVE. • CRANSTON 10, R. I.

ELECTRIC VACUUM FURNACES

It Pays To See Hayes for metallurgical guidance, lab. facilities, furnaces, atmos. generators, gas and liquid dryers.

Forging Ohio Rolls

to shape metal for all Industry

. . . this 2,500 ton forging press, now in operation at the Lima plant, is the latest member of Ohio Steel's family of roll producing equipment.

The giant manipulator, overhead crane, and banks of the latest in car type, natural gas-fired furnaces, with automatic program controls, complete this new forging facility—A modern facility with which to produce Ohio Forged Steel Rolls and Forged Steel Sleeves for back-up rolls.

The Ohio Steel Foundry Co.

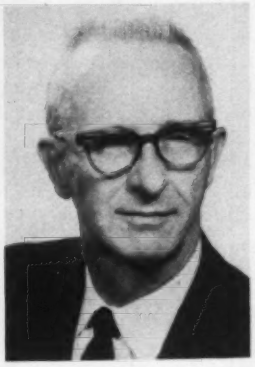
LIMA, OHIO ... *Virtually at the center of the steel industry*

PLANTS AT LIMA AND SPRINGFIELD, OHIO

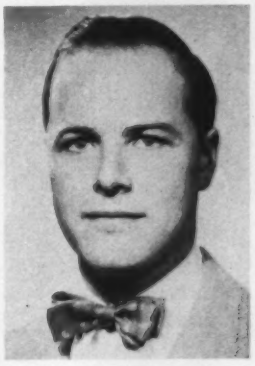
OHIO IRON AND STEEL ROLLS

Carbon Steel Rolls
Onioloy Rolls
Ohioloy "K" Rolls
Flintuff Rolls
Double-Pour Rolls
Chilled Iron Rolls
Denso Iron Rolls
Nickel Grain Rolls
Special Iron Rolls
Nioloy Rolls
Forged Steel Rolls
Forged Steel Sleeves for Back-Up Rolls

WILLIAM G. BANCROFT
Cincinnati Milling plant mgr.



FRED T. L. GRIMM
Ex-Cell-O purchasing dir.



BENJAMIN G. DANN JR.
Hendrick Mfg. production dir.

HAROLD F. WILEY
CEC vice president

William G. Bancroft was appointed manager of the grinding wheel plant, Products Div., **Cincinnati Milling Machine Co.**, Cincinnati. He succeeds **Maurice Gormly,** now manager of the Products Div. Mr. Bancroft, with Cincinnati Milling since 1953, was manager of manufacturing engineering.

Gene A. White was elected president, **Cogsdill Tool Products Inc.**, Oak Park, Mich. He succeeds **Frank A. Cogsdill**, named vice chairman. **Bradley N. Brown** was elected treasurer.

R. P. Adams Co. Inc., Kenmore, N. Y., named **Roland D. Baker** sales manager, Heat Exchanger Div. He was Washington district manager, Ross Heat Exchanger Div., American Radiator & Standard Sanitary Corp.

Victor Brinkman was made manager of production planning and material control, Compressor & Engine Div., **Worthington Corp.**, Buffalo.

Eugene L. Sadowski was made assistant works manager, **Martin Steel Corp.**, Mansfield, Ohio. He is responsible for the Engineering Dept. and all factory production. He was plant manager of United Mfg. Co., Cleveland.

Paul S. Dougherty was elected president of **Chain Link Fence Corp.**, Chicago, to succeed **Robert Hoffman,** retired. Mr. Dougherty is president of Metal Coating Corp., which also operates Medalist Tank and Minneapolis Divisions.

Fred T. L. Grimm, formerly purchasing agent of the Detroit plants of **Ex-Cell-O Corp.**, Detroit, was named director of purchases. He succeeds **Fred Sicklesteel,** retired.

Benjamin G. Dann Jr. was made director of production, **Hendrick Mfg. Co.**, Carbondale, Pa. Associated with Hendrick for the last 18 years, he became plant engineer in 1951.

Dr. I. A. Oehler, executive vice president, was elected president of **American Welding & Mfg. Co.**, Warren, Ohio. He succeeds **W. J. Sampson Jr.**, now chairman. **Howard E. Kaighin,** vice president, was named executive vice president.

Raymond W. Gilbert was made Eastern district manager of refractory metals development for **Climax Molybdenum Co.**, New York, division of American Metal Climax Inc. He replaces **Robert R. Freeman,** recently promoted to civilian markets manager for refractory metals.

Edward J. Verity was appointed manager, Marketing Research Dept., **Garlock Inc.**, Palmyra, N. Y. He was vice president-general manager, Toms River, N. J., plant, Clayton Skiffs Inc., subsidiary of Lukens Steel Co.

S. L. McClurg was named assistant to the manager of tin plate sales, **Weirton Steel Co.**, Weirton, W. Va., division of National Steel Corp. He is succeeded by **W. S. Dorrance** as manager of the Tin Mill Products Div., Order Dept.

Harold F. Wiley, director of the Analytical & Control Div., **Consolidated Electrodynamics Corp.**, Pasadena, Calif., was named a vice president of the firm. In his newly created post, he continues direction of the A&C Div.

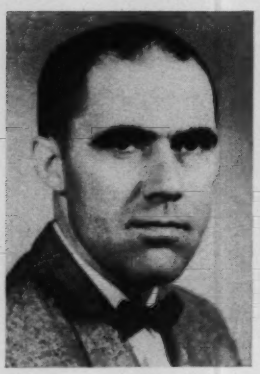
P. D. Shollar, vice president-procurement, and **W. F. Alexander,** director of procurement, **Koppers Co.**, Pittsburgh, were transferred to the office of the president on special assignments. **J. D. Rice,** former assistant director-procurement, was named director of procurement.

James F. McCartney joined **McConway & Torley Corp.**, Pittsburgh, to co-ordinate sales activities of the company's district offices. He formerly served Pressed Steel Car Co., and Duff-Norton Co.

John R. Freeman Jr., vice president-metallurgy and research, **Anaconda American Brass Co.**, Waterbury, Conn., has retired. He will serve as a metallurgical consultant to Anaconda Sales Co., New York. Direction of the metallurgical and research function of Anaconda American Brass will be assumed by **Gilbert C. Strubell,** administrative director of metallurgy and research.

Turner Corp., Sycamore, Ill., elected **Harold V. Engh Sr.** chairman, **Harold V. Engh Jr.** as president. The company was formerly known at Turner Brass Works.

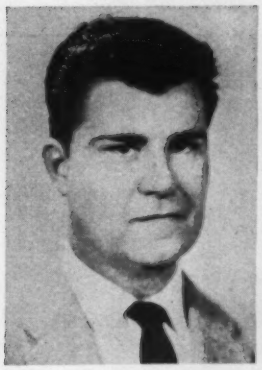
H. F. Froehlich was made works manager of the Royal Oak, Mich., equipment plant, Tractor & Implement Div., **Ford Motor Co.** He was



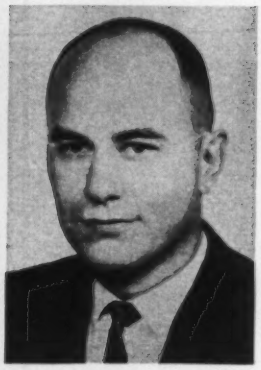
ERNEST E. RUSSELL

RICHARD M. SMITH

Corning Glass and Corhart Refractories posts



KURT W. LEIBFRITZ



JAMES P. FAIRBAIRN

chief engineers of Hannifin divisions

vice president-manufacturing for Sherman Products Inc. before its acquisition by Ford in July.

Ernest E. Russell was made manager of **Corning Glass Works's** refractories plant, Corning, N. Y. He was production superintendent there. **Richard M. Smith** was made manager of a new plant to be constructed at Buckhannon, W. Va., by Corning's subsidiary, **Corhart Refractories Co.**

Heinz O. Spier was named vice president in charge of export operations for **Rolled Steel Corp.**, Skokie, Ill.

Robert J. Koch was made Southwest regional sales manager (Houston) for **Morse Chain Co.**

Alden P. Taber was elected a vice president of **Babcock & Wilcox Co.**, New York, and placed in charge of the Research & Development Div. Since June, 1959, he has been on the president's staff, co-ordinating and directing research and development activities.

Hannifin Co., Des Plaines, Ill., appointed **Kurt W. Leibfritz** chief engineer, air valves, for its Valve & Crown Div., and **James P. Fairbairn** chief engineer, mobile hydraulic cylinders, Power Cylinder Div.

Harry K. Brill was named general sales manager, Atomic & Process Equipment Div., **A. O. Smith Corp.**, Milwaukee. **Andrew L. Lawson** was made manager of atomic equipment.

Roy B. Bender was appointed vice president, Automotive Div., **Studebaker-Packard Corp.**, South Bend, Ind. He continues as parts and service division manager.

Philip T. Rogers was made vice president-general manager, **Arco-Wynn Valve Div.**, Automotive Rubber Co., Detroit. He was a regional manager for Hills-McCanna Co.

Lloyd D. Simonson was appointed general sales manager, **United States Steel Products Div.**, United States Steel Corp., in New York. He was district manager.

Julius J. Harwood was named manager, Metallurgy Dept., at **Ford Motor Co.'s** Scientific Laboratory, Dearborn, Mich.

Calvin W. Hunter was named sales manager for **Hartman Metal Fabricators Inc.**, Waterloo, N. Y. He replaces **Jerome L. Huff**, resigned.

J. E. Goodwin was elected president of **United States Railway Equipment Co.**, and **U. S. Railway Leasing Co.**, Chicago.

Thelma L. Watson was appointed executive vice president and treasurer of **Carter Products Co. Inc.**, Grand Rapids, Mich. Miss Watson has been treasurer for the last ten years, and has also served as sales manager for the Guide Line Light Div. as well as director of advertising for all product divisions.

Kenneth W. Clarke was promoted to product manager, heavy indus-

ALDEN P. TABER

B&W research-dev. v. p.

PHILIP T. ROGERS

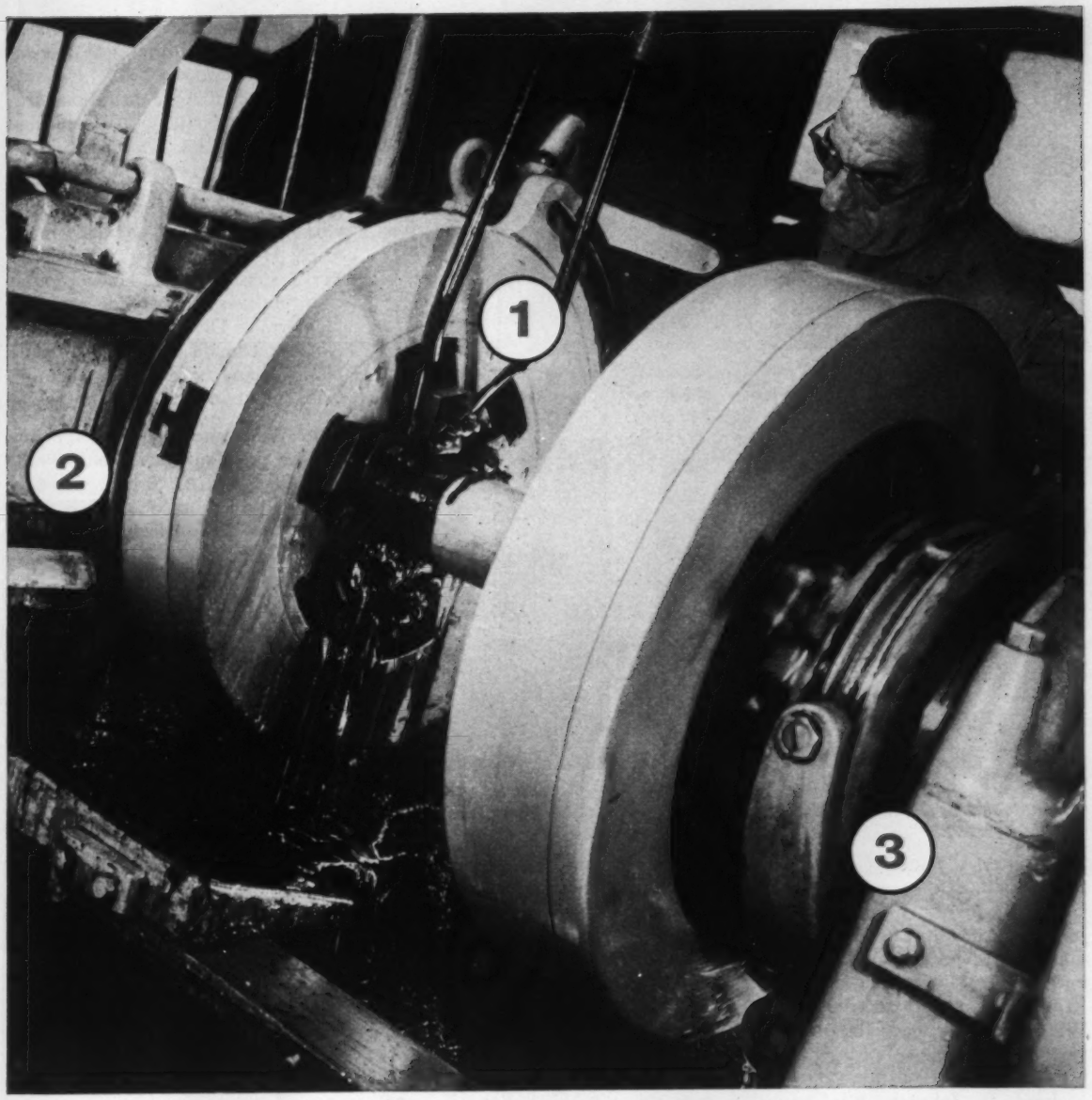
Arco-Wynn Valve v. p.

LLOYD D. SIMONSON

U. S. Steel Products sales

THELMA L. WATSON

Carter Products exec. v. p.



ESSO LUBES HELP BOOST CUTTING EFFICIENCY

1. PENNEX® cutting oils, compounded with fatty materials, are widely used to boost cutting efficiency in threading, tapping and other machining operations on ferrous metals. Featuring high sulfur activity which provides excellent surface finish and low tool wear, Pennex cutting oils have been proven performers over many years.

2. NUTO® hydraulic and circulating oils are inhibited for oxidation and rust protection. They resist foaming and have a high viscosity index for hydraulic uses. They also serve efficiently in gear drives, bearings, and circulating systems.

3. NEBULA® EP multi-purpose grease replaces many single-purpose greases: provides high oxidation stability for long service; lubricates efficiently under high temperature conditions; serves *all* grease-lubricated points, including those where extreme-pressure properties are required.

For further information about Esso lubricants, contact your local Esso office or write: Esso Standard, Division of Humble Oil & Refining Company, 15 West 51st Street, New York 19, New York.

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In Industry after Industry..."ESSO RESEARCH works wonders with oil"

G. KEITH BOGERT
Wilkerson mfg. mgr.

HARRY D. WALLACH
Howe Refining v. p.-gen. mgr.

JOHN W. STOUTENBERG
joins Robin Products Co.

JOHN K. LINCOLN
Micro Switch sales mgr.

ALBERT J. ROSENBERGER
Republic Flow Meters dept. mgr.

FORREST H. RAMAGE
Republic-Pipe Div. sales mgr.

trial systems, **Datex Corp.**, Monrovia, Calif.

John K. Lincoln was named sales manager, **Micro Switch Div.**, Freeport, Ill., Minneapolis-Honeywell Regulator Co. He succeeds **Frank Wilsey**, recently made the division's vice president-sales. Mr. Lincoln was Eastern division sales manager. **Richard F. Johnson** was named Central Area (Cleveland) sales manager, succeeding **Kenneth J. Cumming**, who was promoted to sales manager of Minneapolis-Honeywell's Marion Instrument Div., Manchester, N. H.

Harry C. Jackson was made assistant superintendent, Cold Strip Dept., Yorkville, Ohio, Works, **Wheeling Steel Corp.** He was superintendent of maintenance at the Benwood, W. Va., plant. At the Benwood Works, **Louis F. Jagucki** was named superintendent, continuous buttweld furnaces-primary finishing and galvanizing. **Ross P. Long** was made superintendent of services.

Albert J. Rosenberger, former chief mechanical engineer, was appointed manager of the new Valve Sales & Engineering Dept. of **Republic Flow Meters Co.**, Chicago. **William R. Robinson**, former manager of Republic's St. Louis district office, was appointed valve sales supervisor.

Forrest H. Ramage was made sales manager, Pipe Div., **Republic Steel Corp.**, Cleveland. He succeeds **J. W. Owings**, who has withdrawn for health reasons but will continue as an adviser and will work on special assignments.

Karl R. Wendt was appointed executive vice president of **Colorado Research Corp.**, Broomfield, Colo. He was manager of the Research Dept., in charge of the firm's digital television development program, which he continues to supervise.

Jack H. Rosfeld was elected president of **Hood Chemical Co.**, Ardmore, Pa. He was executive vice president.

G. Keith Bogert was named manager of manufacturing at **Wilkerson Corp.**, Englewood, Colo. He was superintendent of fabrication and processing at Ramo - Wooldridge Div., Los Angeles, Thompson Ramo Wooldridge Inc.

Harry D. Wallach was appointed vice president and general manager, **Howe Refining Co.**, New York, subsidiary of Howe Sound Co. He was vice president of the Nonferrous Div. of Frank Samuel & Co. **Donald Straub** was made plant manager, Howe Refining Corp. plant in Sewaren, N. J.

John W. Stoutenberg was appointed vice president-sales, **Robin Products Co.**, Warren, Mich. He had been with Korhumel Steel & Aluminum Co., Evanston, Ill.

Frank W. Rickard was elected a group vice president of **Borg-Warner Corp.**, Chicago. He is president of Mechanics Universal Joint Div. at Rockford, Ill. He will have headquarters in the corporation's central office in Chicago.

Lawrence V. Whistler Jr. was elected president of **S. B. Whistler & Sons Inc.**, Buffalo, succeeding his father, now chairman.

Robert W. Kerr resigned as president of **Fairbanks, Morse & Co.**, Chicago. **Alfons Landa**, chairman, continues as chief executive officer.

Hyster Corp. named **Hugh Richmond** supervisor of Special Products Engineering Dept. activities in Portland, Oreg., and Danville, Ill. **Dick Chase** was named supervisor of the department's Danville branch.

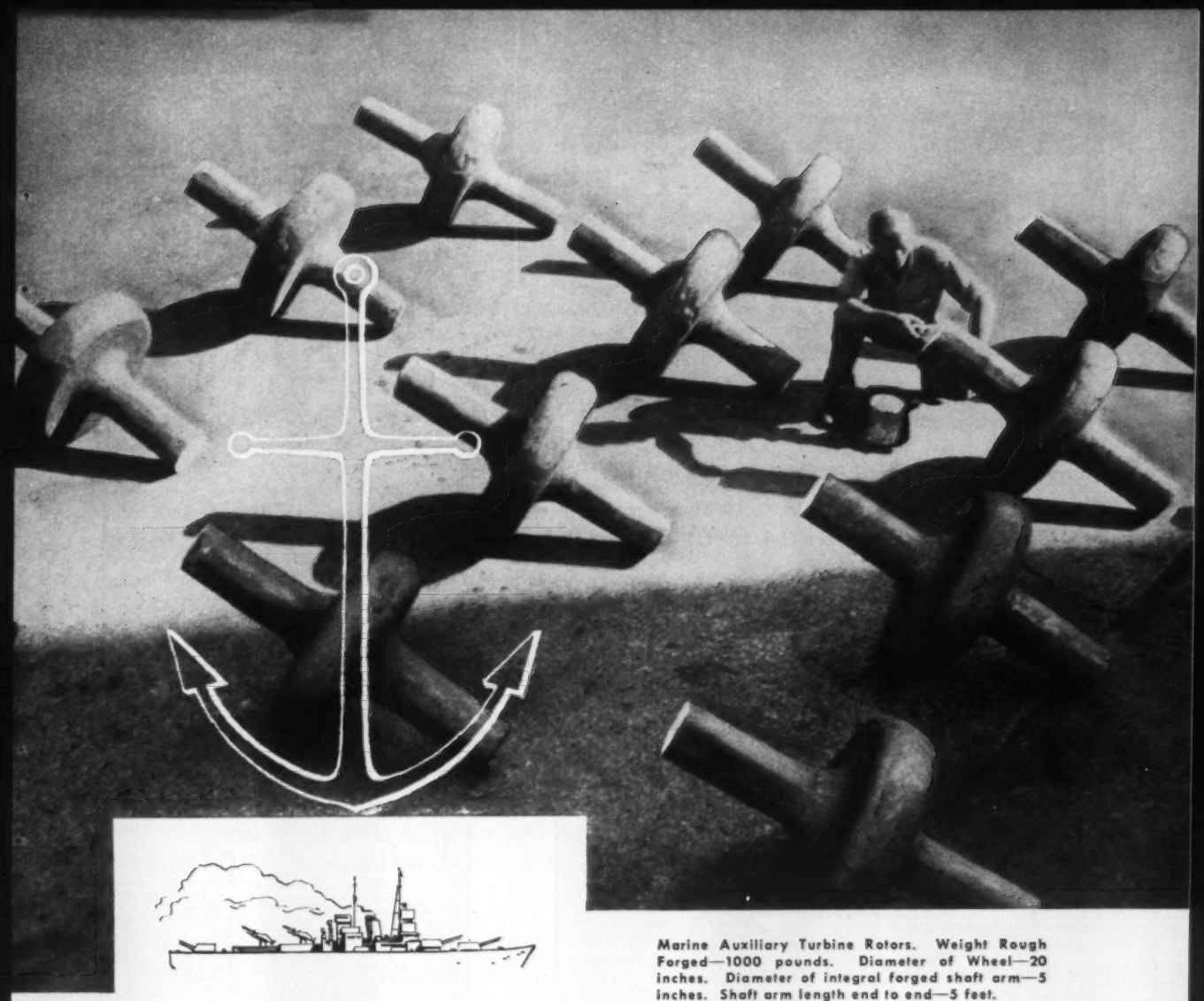
Walter W. Edens was appointed assistant director, Research Div., **Allis-Chalmers Mfg. Co.**, Milwaukee. He was supervisor of metallurgical research.

OBITUARIES...

Howard E. Lemmerman, 63, purchasing director, **Midland-Ross Corp.**, Cleveland, died Sept. 27.

Jens Duus, 57, factory manager for **Buffalo Meter Co.**, Buffalo, died Sept. 24.

Owen J. Pritchard, 66, executive vice president, **Milwaukee Solvay Coke Co.**, Milwaukee, died Sept. 24.



Marine Auxiliary Turbine Rotors. Weight Rough Forged—1000 pounds. Diameter of Wheel—20 inches. Diameter of integral forged shaft arm—5 inches. Shaft arm length end to end—5 feet.

Forged Alloy Steel Rotors Sail the Seven Seas . . .

These forged alloy steel rotors will show up at the heart of auxiliary turbines driving boiler feed pumps on large maritime and naval vessels. Rough machined, they weigh slightly less than 1000 pounds each.

Here is visual proof of the versatility of our steel forging production capabilities . . . versatility enabling us to meet the specifications for components required by a wide diversity of industrial and marine machinery.

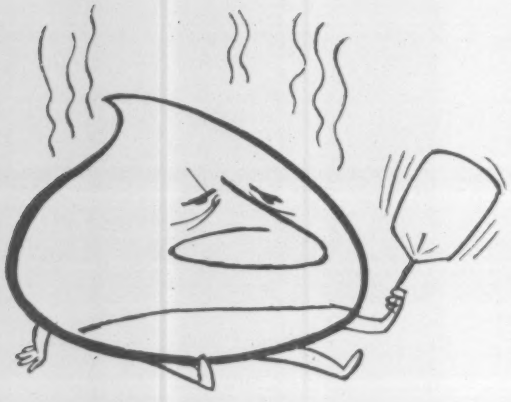
The same careful quality control procedures as are accorded to turbine rotors weighing 40 tons and more, are standards of operation in producing these relatively small components.

You are safe in placing your parts forgings in our hands. It will pay you well to consult with us on your requirements for any size or shape of steel forgings and castings.

ERIE FORGE & STEEL CORPORATION

ERIE. PENNSYLVANIA

How hard is hard? Tests by a locking pin manufacturer showed that hardness varied from 34 to 61 on Rc Hardness Scale. This spotty result caused a high rate of rejects, and a substantial loss of profits.



Sinclair engineers, using the Sinclair Quenchol Demonstrator, found the culprit: the quenching oil formerly used lacked cooling power, only 784 rating against 1225 minimum for Sinclair QUENCHOL 521. Now, with Sinclair QUENCHOL 521, hardness is uniformly high–59 to 65 Rc. Working loads are now 67% higher–3 tons to 5 tons per quench. Test your present oil. Call your local representative or write

Sinclair

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Rolled Steel Corp. Forms Division to Boost Exports

FOREIGN countries cannot undercut U. S. production costs in every instance, says Irwin D. Harris, chairman, Rolled Steel Corp., Skokie, Ill., in announcing the establishment of an export division: Rolled Steel International.

Mr. Harris asserts demand for flat rolled stock is great in the markets of Western Europe as well as in Latin America and the Far East.

His claim is supported by statistics just released by the American Iron & Steel Institute which show that during July exports of iron and steel products exceeded imports. They were heaviest in cold rolled sheets, totaling 152,494 tons and valued at $25,452,206 (see Page 223).

Production facilities in the Latin American and Far Eastern countries are scarce; those countries have to import steel to meet manufacturing requirements.

• **Offers Services**—"From the warehouse standpoint," Mr. Harris says, "the exporting of steel is a logical function when you consider the special marking, handling, and packaging requirements in shipping steel overseas."

Rolled Steel will export its complete line of aluminum, stainless steel, and carbon and galvanized steel, including steel sheets, bars, plates, angles, coils, and structurals.

The new division will be directed by Heinz O. Spier. It will ship directly to foreign customers via the Port of Chicago.

Since most goods are produced in the Midwest which has the facilities of the St. Lawrence Seaway, Chicago is a strategic place for U. S. export activities, Mr. Harris points out.

Operations Shifted Abroad

Remington Rand Div., Sperry Rand Corp., New York, will move all domestic production of standard office and portable typewriters from Elmira, N. Y., to three of its five European plants: Hillington, Scotland; Lyons, France; and Naples, Italy. Remington expects to increase production of electric typewriters at the Elmira plant.

Eastern Stainless Expands

Eastern Stainless Steel Corp., Baltimore, is erecting a 20,000 sq ft warehouse for storage of plates. The firm recently completed a $10 million expansion and modernization program. W. F. Schneid is vice president and general manager.

Webb Wire to Build Mill

Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J., will construct a wire drawing mill with a working area of 50,000 sq ft. It will be built in North Brunswick Township and will be completed in February. The division makes precision, stainless steel, spring wire; needle wire; and nickel alloy, electrical wire.

The plant layout and material handling systems will help double production of some items. New wire drawing machines and a new electric annealing furnace will be added to existing equipment.

Wheeling Sells Factory

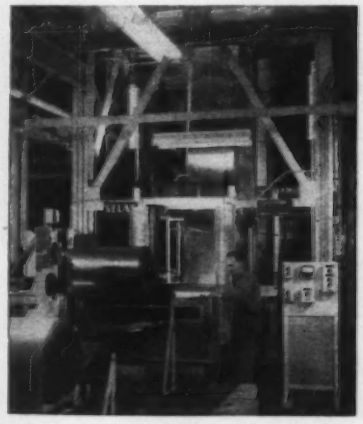
Trilobe Coupling Corp., New York, has purchased the Ackerman factory, Wheeling, W. Va., from Wheeling Steel Corp. The purchase includes factory buildings, machinery, stores, and equipment.

Rolling Capacity Doubled

Quaker State Metals Co., Lancaster, Pa., has installed a tandem mill, doubling its cold rolling capacity. The mill takes 1/4 in. coils and reduces the strip to 0.062 in. in a single pass, taking 50 per cent reduction in each stand, at a runout speed of 1500 fpm. The mill was built by the Rolling Mill Div., E. W. Bliss Co., Salem, Ohio. T. F. Zimmerman, vice president of manufac-

(*Please turn to Page* 114)

To meet demands for perfect finish on stainless and nickel Thinstrip®, Somers installs unique new annealing furnace.



This new Selas vertical continuous annealing furnace assures uncontaminated, commercially unmarred surfaces as well as uniform temper and faster delivery on stainless, nickel and nickel alloy Thinstrip up to 25" wide. But this is only part of the story of Somers' quality. Sendzimir rolling mills, Accu-Ray gauging plus 50 years leadership in thin gauge metals (from .010 down to .000125") are a few of the features Somers offers to assist you with your Thinstrip® problems.

Write for Confidential Data blank — no cost or obligation.

FOR EXACTING STANDARDS ONLY

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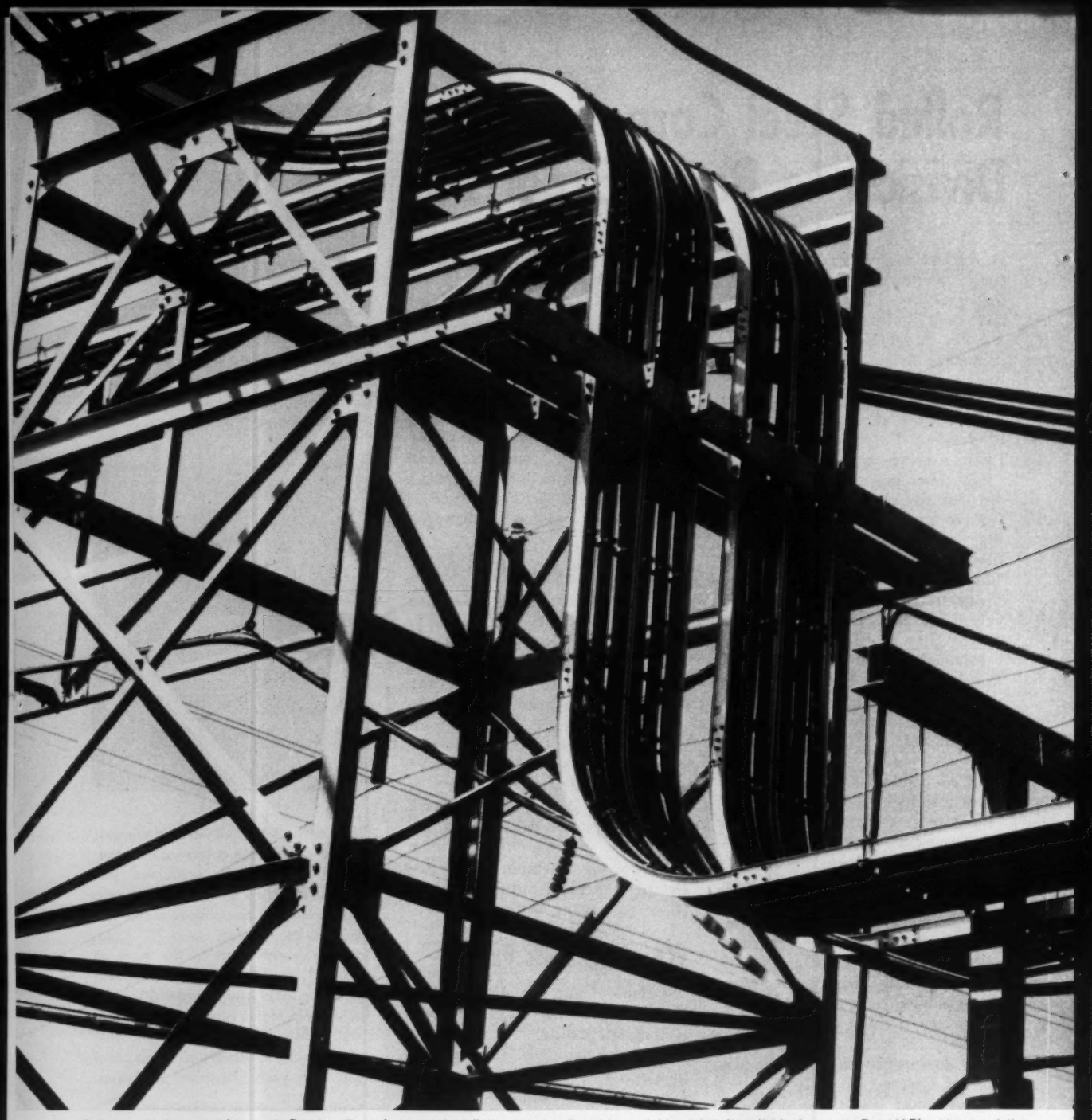


Indoors or out, rugged Anaconda Duralox means fast, easy installation because it needs no rigid conduit. Its reliable Anaconda Butyl (AB) rubber insulation

PROBLEM:

Installing high-voltage cable without rigid conduit

SOLUTION:

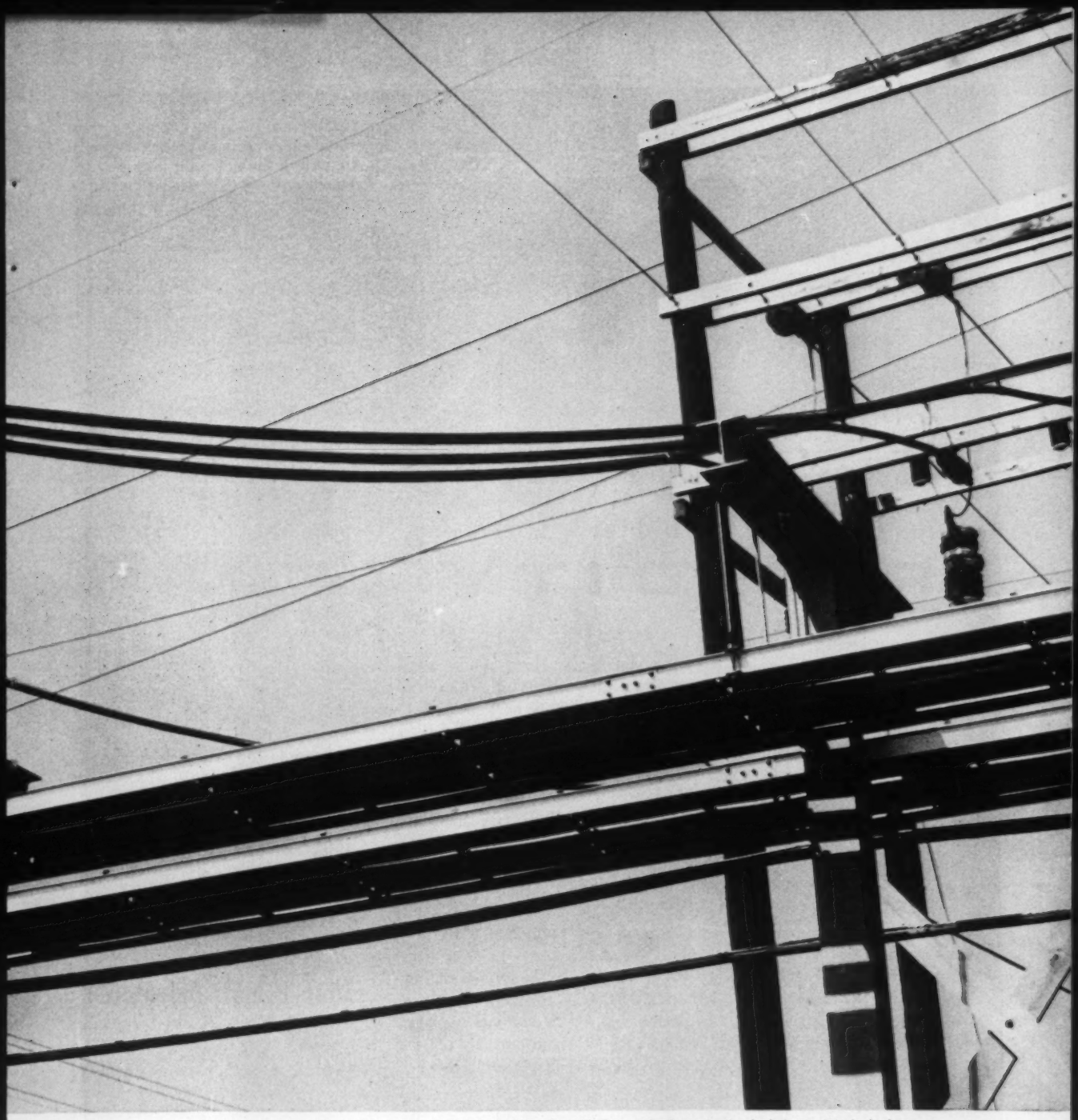
Use Duralox, Anaconda Butyl (AB)-insulated interlocked-armored cable.

You save time . . . you save money . . . you save manpower —with Anaconda butyl-insulated Duralox.* For Duralox has its own conduit of durable, yet flexible, metallic armor.

This means fast and easy installation in long runs over and around obstructions, in trays, indoors or out—and all without the expense, trouble and time of laying rigid conduit and pulling cable through it.

Duralox will fit into your long-range plans as well—because it's 100% salvageable and can be readily moved as your plant layout changes.

Duralox's lower reactance—because of the close spacing of the conductors—results in reduced voltage drop



offers extra protection against ozone and moisture. Above is an installation of Duralox with thermoplastic protective jacket over interlocked armor.

and more efficient power distribution. Available in ratings of 5 kv, 15 kv, and higher, in addition to lower voltage ratings.

Whether your problem is wiring a new plant or rewiring an old one—see the Man from Anaconda. Duralox is just one of the many types of Anaconda wire and cable that can help you increase plant flexibility . . . reduce operating costs . . . bring in new power for your needs today and tomorrow. For full information on Anaconda Duralox Cable write for Bulletin DM-5606 to: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Reg. U. S. Pat. Off. 59207

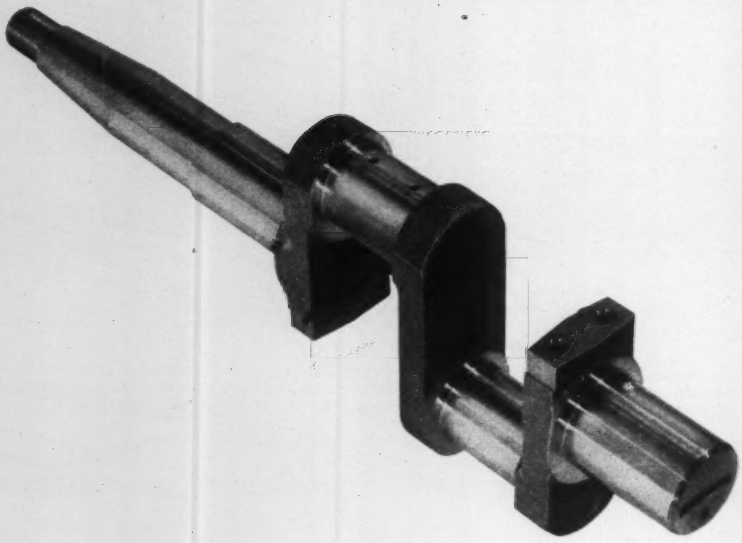
DURALOX HAS ANACONDA BUTYL (AB) RUBBER INSULATION FOR

- extra-high resistance against ozone
- exceptional moisture resistance
- 22% more current-carrying capacity than 70° centigrade insulation

SEE THE MAN FROM

ANACONDA®

FOR BUTYL-INSULATED
DURALOX POWER CABLE



RIGIDITY

A CASE IN POINT—This seventy pound ductile iron crankshaft is made for compressors manufactured by The Brunner Division of Dunham-Bush, Inc. The increased loads and speeds called for by new compressor design specifications required rigidity and strength beyond the limits of the cast iron alloy shafts formerly used. Ductile iron was chosen because the rigidity, tensile strength, fatigue strength and wear characteristics comfortably exceed operating requirements. A major bonus—the existing pattern equipment could be used for the ductile iron castings, thus saving the high cost of dies needed for steel forgings.

Ductile iron has most of the engineering advantages of steel yet it can be designed with the same flexibility and cast with the same procedures as gray iron. The 120-90-02 grade used in this case has an elastic modulus of about 24 x 10^6 psi, 42,000 psi endurance limit, and 300 BHN. The 120,000 psi tensile strength is double that of the previous crankshaft. Hamilton Foundry regularly casts all grades of ductile iron and high alloy Ductile Ni-Resist.

When new and unusual design problems arise in the selection of metal and the casting of parts, you will find that the skill and integrity of your foundry is your best insurance that specifications—and delivery schedules—will be met.

GRAY IRON • ALLOYED IRON • MEEHANITE® • DUCTILE (NODULAR) IRON • NI-RESIST • DUCTILE NI-RESIST • NI-HARD

HAMILTON FOUNDRY INC.

1551 LINCOLN AVENUE • HAMILTON, OHIO • TWinbrook 5-7491

(*Concluded from Page* 111)

turing at Quaker State, said that the company may have set a record in getting the new mill into production, as it started turning out aluminum for the building industry one week after installation was completed. The company is a division of Howe Sound Co., Salt Lake City, Utah.

Danville Div. Enlarged

Bohn Aluminum & Brass Corp., Detroit, is expanding the plant facilities of its Danville (Ill.) Div. A 28,000 sq ft plant addition and 2000 sq ft of additional dock space are being constructed. The plant makes heat transfer equipment for heating, air conditioning, and commercial refrigeration.

Hyde Park Foundry Builds

Hyde Park Foundry & Machine Co., Hyde Park, Pa., is expanding and modernizing its machine shop facilities. A 27,000 sq ft machine shop building is being erected to augment erection and heavy tool facilities. When this project is completed this fall, production facilities at Hyde Park will occupy about 150,000 sq ft.

Scott Castings Expands

Scott Castings Corp., Buffalo, will build a $50,000 addition to its plant for offices. The company specializes in nickel and Monel castings.

Alcan Installs Big Mill

Northern Aluminium Co. Ltd., principal fabricating subsidiary of Aluminium Ltd., Montreal, Que., changed its name to Alcan Industries Ltd. It inaugurated on Oct. 6 one of the largest aluminum rolling mills in the world. The mill can roll plate to widths of 11 ft for use in shipbuilding and wide sheets for structural and transportation uses.

Star Cutter Extends Line

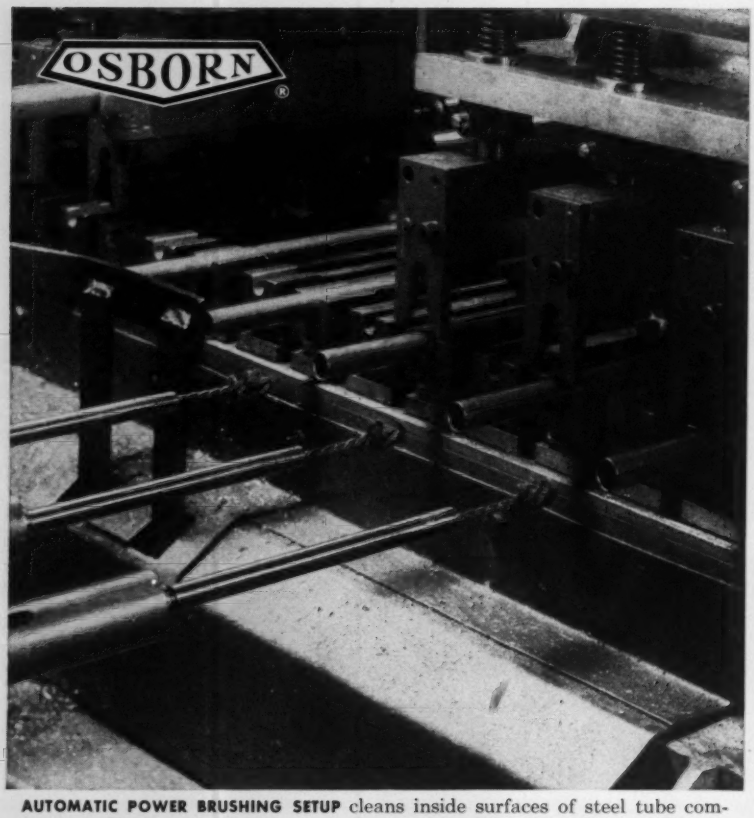
Star Cutter Co., Farmington, Mich., purchased from Baker Bros. Inc., Toledo, Ohio, its line of keyseaters, profile grinders, and keyseater cutters. Production of the machines and cutters is underway

Tempilstik°. . . temperature indicating crayons

TEMPILSTIKS° are widely used as a standard method of determining temperatures in welding procedures, metal working and heat treating, steam trap maintenance, tire-retreading, plastic forming and hundreds of other heat-dependent operations. Available in 80 different temperature ratings . . . $2.00 each. Most industrial supply houses carry Tempilstiks°. If yours is an exception, then write direct to us for further information.

Tempil° CORPORATION • 132 West 22nd St., New York 11, N. Y.

Visit us at Booth #1327—A.S.M. Show—
Philadelphia Trade & Convention Center—Oct. 17-21.



AUTOMATIC POWER BRUSHING SETUP cleans inside surfaces of steel tube components. Conveyor stops for every three tubes while three Osborn Helituf® brushes (operating at 380 rpm) advance through more than half the tube length. As they withdraw, three more brushes enter from the opposite end to complete the operation. Tube interiors are power brushed clean . . . all burrs removed. Rate: 750 pieces per hour.

FAST CLEAN-OUT for tubing

. . . 12,000 a day with OSBORN power brushing

Needed: a fast, low-cost way to clean the inside surfaces of these steel tube components. This auto equipment maker picked Osborn power brushing to do the job.

Here's How: Mounted on a special six-spindle machine, Osborn Helituf® brushes give the tubes a quick, thorough clean-out. Tubes are cleaned three at a time, with total production at 12,000 pieces per day on two 8-hour shifts. Hidden dirt, burrs and weld slag are completely removed from the hard-to-reach inside surfaces. The operation is fully automatic, effective, economical.

Tough metal finishing jobs of *every* description—deburring, cleaning, polishing, precision blending—can be simplified with advanced Osborn power brushes and brushing methods. An **O**sborn **B**rushing **A**nalysis—made in your plant now at no obligation—can show you how to increase production, improve quality and trim your costs. Write or call *The Osborn Manufacturing Company, Dept. S-27, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

Osborn Brushes

Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes • Foundry Production Machinery

at the Star plant. Within the last six months, the plant facilities have been increased 50 per cent to provide a total of 50,000 sq ft of floor space.

Fastener Plant Enlarged

Holland Mfg. Co., Baltimore, is erecting a 13,000 sq ft plant addition, increasing total area to over 40,000 sq ft. The firm is a manufacturer of tacks and plans to broaden its product line to include fasteners and other packaged, shelf hardware items. The project is expected to be completed by the end of this year.

Installs Extrusion Press

Pittsburgh Aluminum Alloys Inc., Murrysville, Pa., has completed an expansion program with the installation of a 1500 ton Loewy extrusion press in its new 60,000 sq ft plant. The plant is equipped for the manufacture of custom aluminum extrusions. Basic auxiliary equipment includes an Ajax Magnethermic induction billet heater, walking beam runout tables, water quench tanks, and a 15,000 lb aging furnace. Tool and diemaking facilities for customer requirements have been expanded.

Electronics Firm Expands

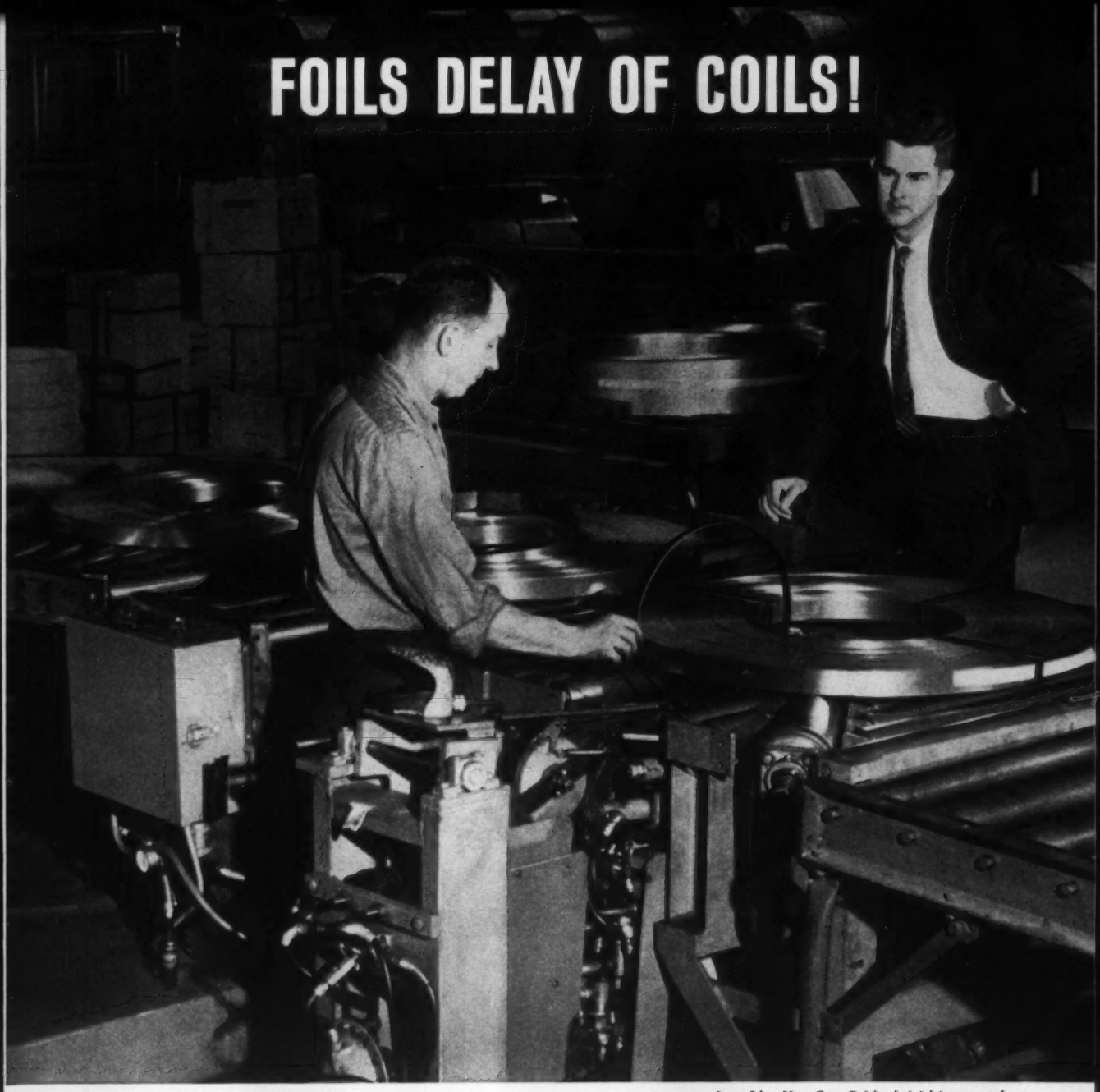
Applied Microwave Electronics Inc., Baltimore, plans to build new manufacturing facilities. The firm makes components for space satellites, missiles, radar, communications, aerial navigation and guidance controls. J. Kelsey Burr III is president.

ASSOCIATIONS

New officers of the **National Foundry Association**, Chicago, are: President, C. A. Carolin, Carolin Foundry & Machine Co., Detroit; and vice president, H. M. Winterson, Blaw-Knox Co., Pittsburgh. W. G. Greenlee, Greenlee Foundry Co., Chicago, was re-elected treasurer. C. T. Sheehan continues as executive secretary.

Association of Iron & Steel Engineers, Pittsburgh, elected these of-

FOILS DELAY OF COILS!



Acme Idea Man Gene Fairbank (right) suggested Idea No. S4-12 to United Flat Rolled Products, Chicago.

United Flat Rolled Products, Chicago, beat bottlenecks in slit coil production with a conveyorized Acme Steel F4 Strapping Machine—and tripled production capacity in the process!

Slow hand strapping methods tied up slitting equipment as much as 45 minutes per hour. Now, slit coils flow smoothly from slitter to strapping machine on roller conveyors. One operator, handling both coil tying and unitizing operations, keeps well ahead of two slitters.

Solving sluggish production problems is an every-day challenge to your Acme Idea Man. For full details, call him or clip the coupon.

ACME STEEL IDEA LEADER IN **STRAPPING**

ACME STEEL COMPANY
AcmeSteelProductsDivision
Dept. SBS-100
135th St. & Perry Ave.
Chicago 27, Ill.

Please send me Idea No. S4-12 and examples of how major companies in my field use Acme Steel Strapping.

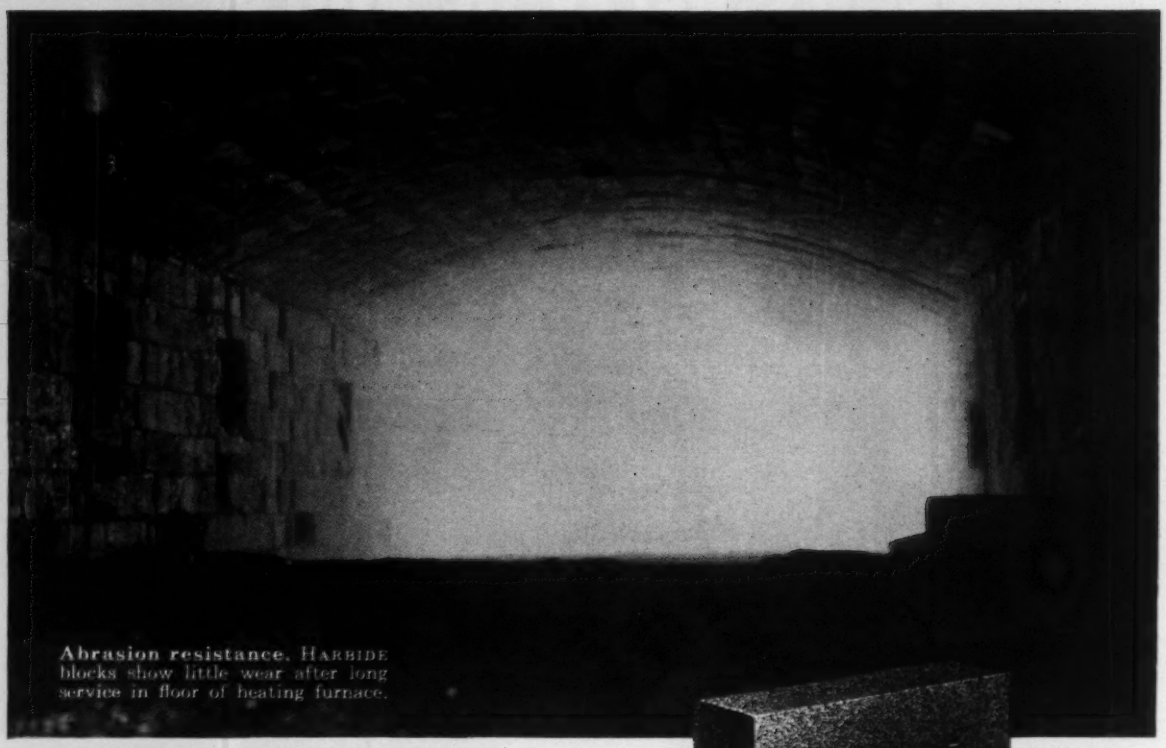
*Name*_____

*Title*_____

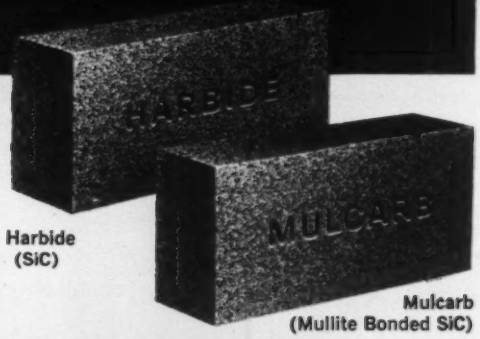
*Firm*_____

*Address*_____

*City*_____ *Zone*____ *State*_____



Abrasion resistance. HARBIDE blocks show little wear after long service in floor of heating furnace.



Harbide (SiC)

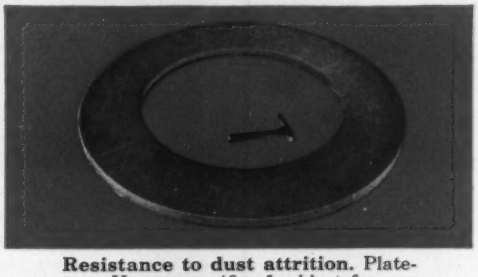
Mulcarb (Mullite Bonded SiC)

HARBISON-WALKER SILICON CARBIDE REFRACTORIES

prove their unusual worth in many applications

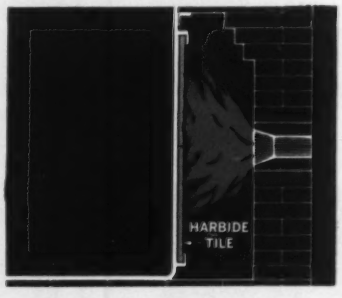
The singular combinations of physical and chemical properties of Harbison-Walker silicon carbide refractories are unmatched by other types and classes of commercial refractories.

Noteworthy properties are—high thermal conductivity—great resistance to mechanical abrasion over a wide range of temperatures—resistance to various fluxes—high temperature strength—low thermal expansion and low spalling tendency. Their high resistance to oxidation and their volume stability under severe temperature conditions contribute further to the exceptional service experienced with these Harbison-Walker brands.



Resistance to dust attrition. Plate-type HARBIDE orifice for blast furnace raw gas scrubber.

Corrosion resistance, Protection against burning, with advantage of high heat transfer in galvanizing tank.



HARBISON-WALKER REFRACTORIES COMPANY AND SUBSIDIARIES

HW 60-22

General Offices: Pittsburgh 22, Pa.

WORLD'S MOST COMPLETE REFRACTORIES SERVICE

ficers: President, C. E. Pritchard, Alan Wood Steel Co., Conshohocken, Pa.; first vice president, H. L. Jenter, American Steel & Wire Div., U. S. Steel Corp., Cleveland; second vice president, C. W. Bruce, Republic Steel Corp., Cleveland; treasurer, H. R. Knust, Bethlehem Steel Co., Sparrows Point, Md.; and secretary, N. C. Michels, Tennessee Coal & Iron Div., U. S. Steel Corp., Fairfield, Ala.

Contractors Pump Bureau, Washington, elected these officers: Chairman, J. H. Hase, C. H. & E. Mfg. Co., Milwaukee; and vice chairman, C. H. C. Van Pelt Jr., Leyman Mfg. Corp., Cincinnati.

Society of Mining Engineers (constituent of AIME), New York, elected these officers for 1961: President, J. C. Gray, U. S. Steel Corp., Pittsburgh; president-elect, W. E. Stephenson, Allen - Sherman - Hoff Pump Co., Paoli, Pa.; and vice president, E. G. Fox, Bituminous Coal Operators Association, Washington.

Thomas A. Marshall Jr. has been elected executive secretary of the **American Society for Testing Materials,** Philadelphia. Fred F. Van Atta has been elected treasurer. Raymond E. Hess will continue as associate executive secretary and R. J. Painter will continue as consultant to the executive secretary.

NEW OFFICES

Precision Extrusions Inc., Bensenville, Ill., opened a sales office at 2034 College Ave. S.E., Grand Rapids, Mich. The firm specializes in the production of extruded aluminum. Frank Buist Jr. is manager of the office.

Baird-Atomic Inc., Cambridge, Mass., opened an office in Cleveland for the sale and service of its atomic instruments. Alexander V. Evans is in charge. The firm makes spectrochemical, infrared, and electronic instruments, and atomic instrumentation.

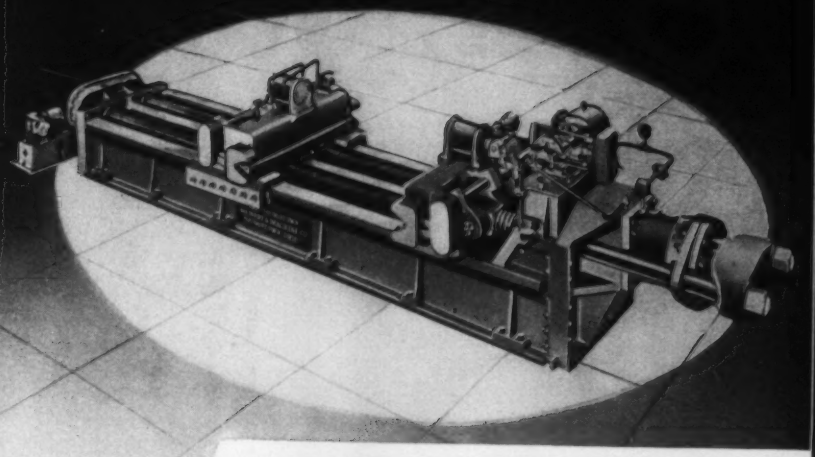
Alpha-Molvkote Corp., Stamford, Conn., established a branch office and technical service center at 2645

(*Please turn to Page* 122)

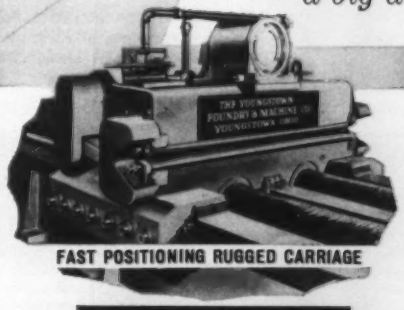
"YOUNGSTOWN"

New Carriage-Type Design

STRETCHER LEVELER



a small difference in design makes a big difference in RESULTS...



FAST POSITIONING RUGGED CARRIAGE

WEDGE TYPE HEADS with WAFFLE TYPE GRIPPER JAWS assure flatness of sheet-ends.

Rugged Three Way fabricated Steel Bed insures utmost rigidity

- CONSERVES VALUABLE FLOOR SPACE
- SPEEDS STRETCHING OPERATION
- AIDS QUALITY CONTROL

The Hydraulic Stretcher Leveler pictured is 800,000# Capacity capable of stretcher leveling mild cold rolled sheets 30" to 62" wide, 30" to 168" long, up to .180" thick in either single or multiple sheets.

A complete range of sizes . . . built from 10,000# for aluminum extrusions to 2,000,000# for stretching plate. New performance throughout a long life of service is assured by traditional "YF&M" rugged construction. Write for Complete Information.

The Youngstown Foundry & Machine Company

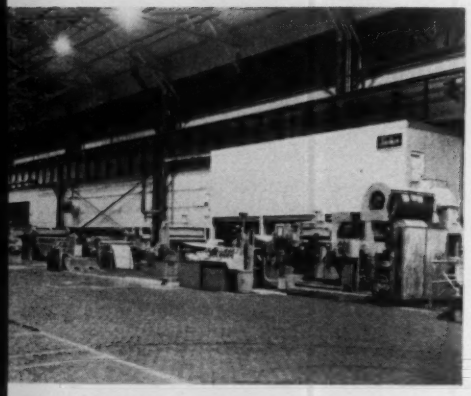
Serving Industry Since 1885

Youngstown 1, Ohio

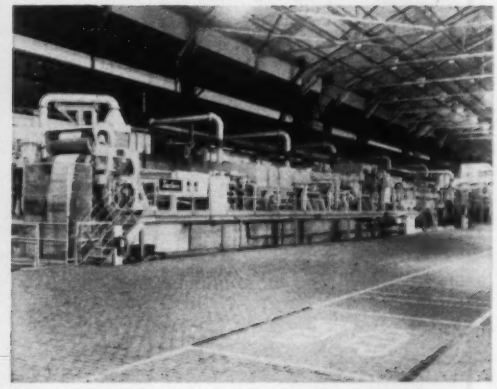
33

complete normalizing line:

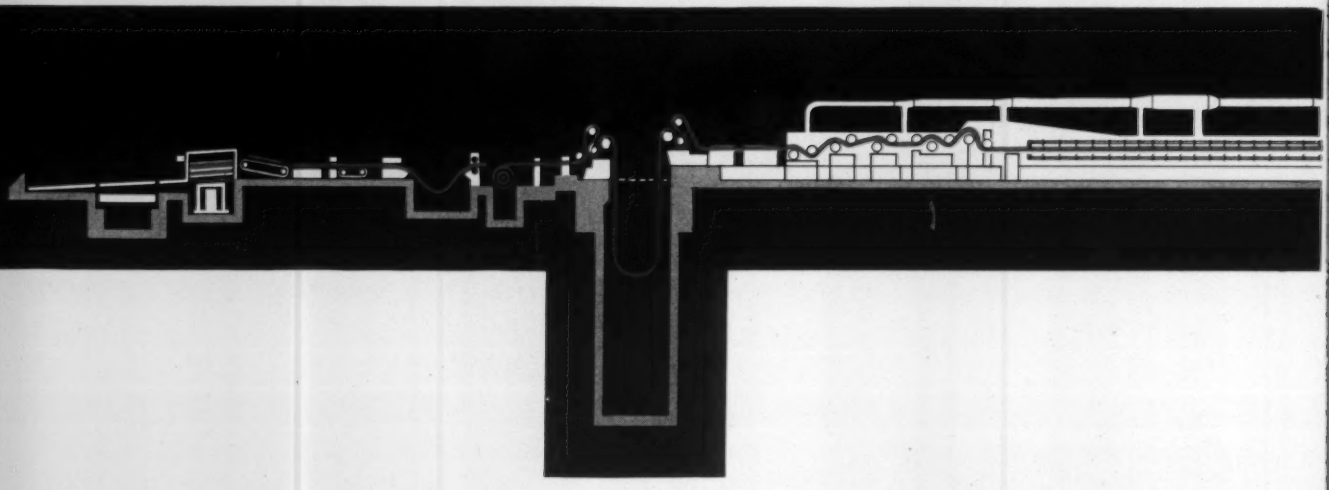
ALL SURFACE!



Exit end of the line, showing looping pit, "recoiler," automatic shear and sheared sheet piler.

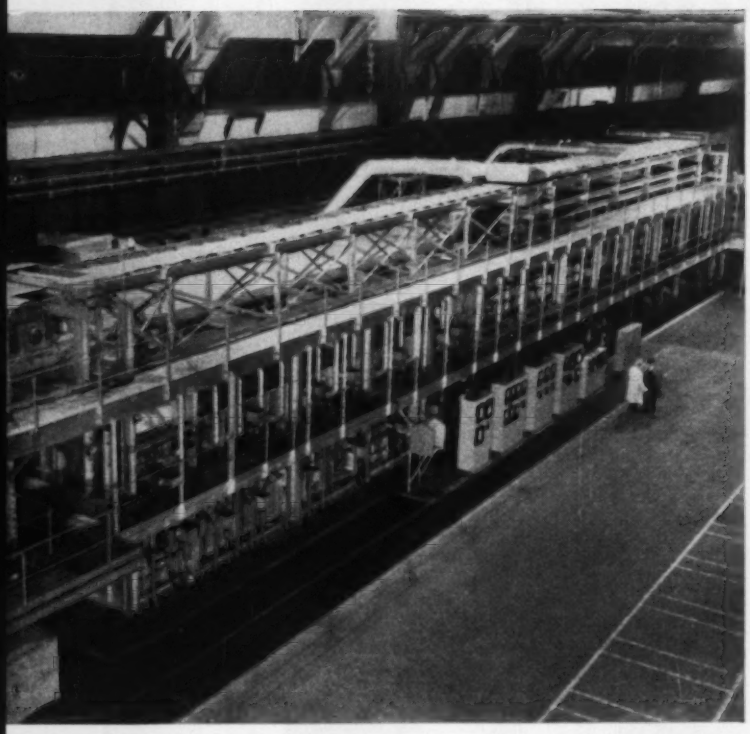


Pickling section includes acid bath, water rinse tank, brush scrubbers, alkali tank and dryer, all installed by Surface. This view shows the exit end of the section.

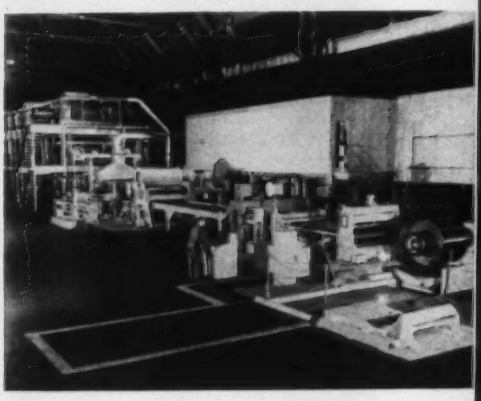


from payoff...to payoff

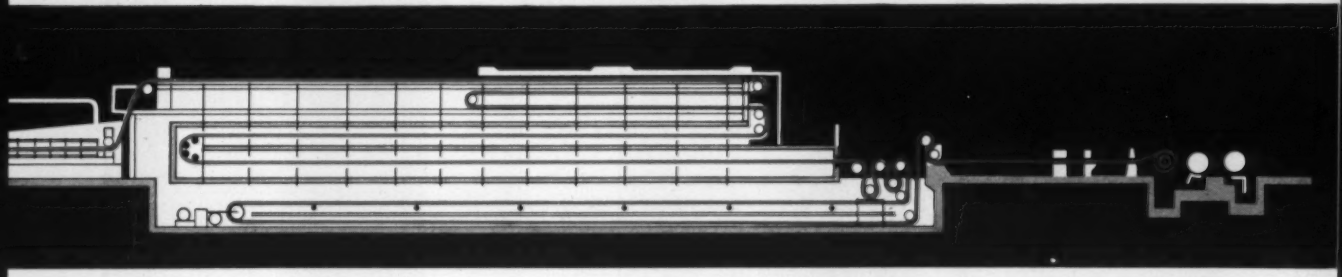
Worldwide engineering and manufacturing facilities through associates in Australia • Belgium • France • Germany • Great Britain • Italy • Japan



Rockwells in the low 40's are achieved consistently in this three-level normalizing furnace. Heating zone is on the lower furnace level; convection cooling in the middle; air blast cooling at the top. A horizontal "looper" is located underneath the furnace.



Payoff reel marks the entry of low carbon stock after cold rolling. Speeds of 150 fpm on 60" wide strip are attained.



This complete new Surface normalizing line for vitreous enamel stock started paying off on its first day of operation. For example, its capacity of 30,000 lbs. an hour puts this mill forcefully into the market for deep draw quality strip. More than adding new selling power, this big line increased productivity per operator by an almost unbelievable amount.

From payoff reel to real payoff, the entire installation is a graphic demonstration of Surface's qualifications as prime contractor. Applying its global experience in metallurgy, combustion, chemistry, and mechanization, Surface engineered and installed the complete line.

Take the opportunity now to evaluate the prime contracting skills available at Surface, and mobilize them for your profit, ***wherever heat is used in industry.***

Surface

SURFACE COMBUSTION *2408 Dorr Street, Toledo 1, Ohio*

A Division of Midland-Ross Corporation

New! Kinnear POWER OPERATOR

FINEST ROLLING DOOR OPERATOR EVER DESIGNED

Adds more efficiency than ever to KINNEAR ROLLING DOORS

FEATURES:

New "Removable" Design — doesn't disturb auxiliary hand-chain operator.

Any Mounting! Vertical or horizontal — on door or wall bracket, or through-the-wall!

Easy Installation. Simple in-the-field control-wiring to a terminal strip.

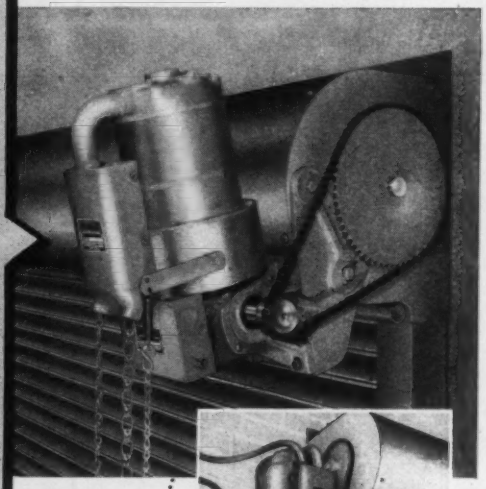
Reserve Power for smooth action regardless of wind pressure, drifted snow, collected grime, or extra years of usage.

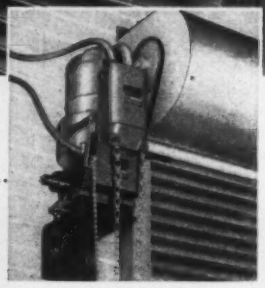
Thermal Protection Against Overload — motor cuts out before damage can occur.

New Worm Gearing for highest efficiency and longest service.

Centrifugal Clutch transmits motor action to door with no shock. Prevents motor stalls and overload damage.

Seven Sizes! Capacities for doors of any size!





MOUNTS ON DOOR

OR ON WALL....

(OR THROUGH THE WALL)

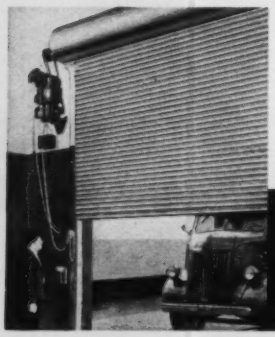
A new high in door efficiency is reached in Kinnear Rolling Doors equipped with the new Kinnear "Series Three" Power Operator. This is an *all-new* concept in motorization for rolling doors — designed with a single goal in mind — to *reduce to minimum* all chance for troubles from overload, torque shock, constant start-stop action—in a motor that assures easiest installation and maintenance, and permits any type of mounting.

The "Series Three" Kinnear Power Operator, like the Kinnear Rolling Door itself, is the finest achievement today's engineering skills can produce.

Write for new Power Operator Bulletin

The KINNEAR Mfg. Co.

FACTORIES: 1780-1800 Fields Avenue, Columbus, Ohio
1742 Yosemite Avenue, San Francisco 24, Calif.
Offices and Agents in All Principal Cities



KINNEAR
ROLLING DOORS
Saving Ways in Doorways

(*Concluded from Page* 119)

W. Peterson Ave., Chicago. The firm produces molybdenum disulfide specialty lubricants. R. B. Dost is Midwest general manager.

CONSOLIDATIONS

Dresser Industries Inc., Dallas, purchased **Podbielniak Inc.**, Chicago, producer of centrifugal solvent extractors, laboratory fractional distillation apparatus, and packaged distillation plants.

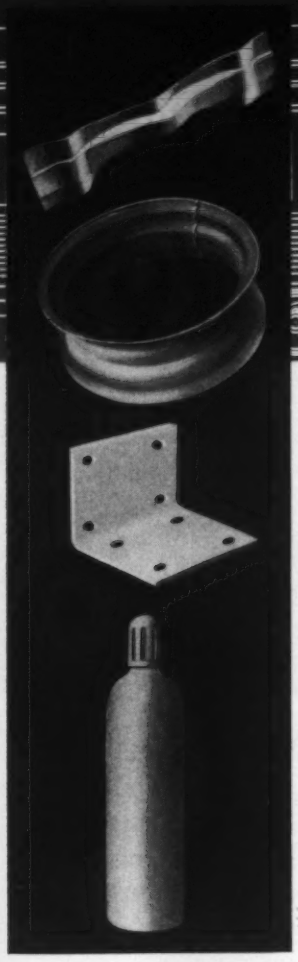
Pfaudler Permutit Inc., Rochester, N. Y., acquired **AeroChem Research Laboratories Inc.**, Princeton, N. J. AeroChem will continue to operate under the direction of Dr. H. F. Calcote, vice president and director of research.

Baruch-Foster Corp., Dallas, is acquiring **American Steel Rolling Mills Inc.**, Long Beach, Calif. A rolling mill being constructed at Long Beach is expected to produce annually 24,000 tons of reinforcing bars and will have an ultimate capacity of 120,000 tons. Arrangements are being made for production of bar products, strip, and special sections. The mill will be capable of rolling alloy and stainless steels, and exotic metals, such as beryllium.

Siegler Corp., Los Angeles, will purchase **Jack & Heintz Inc.**, Cleveland, subject to approval of stockholders. The Cleveland firm produces electrical, hydraulic, and mechanical components for aircraft and missiles. Siegler is an electronics and heating appliance manufacturer.

Waltham Precision Instrument Co., Waltham, Mass., purchased **Boesch Mfg. Co.**, Danbury, Conn., producer of toroidal coil winding machines, accessories, and control instruments.

Simon Bros., Sharon, Pa., has been merged into **Crown Metal & Salvage Co.**, Youngstown. Officers of the consolidated firm are: President, E. H. Bogen; vice president-purchasing and sales, Nate Simon; manager of yard operations, George Simon.



Columbium flat-rolled steels

Do you need a steel, to use in the "as rolled" condition? Or a steel which has high strength, good weldability, good formability?

More and more manufacturers are turning to columbium flat-rolled steel products, for columbium sheet, strip or plate gives an answer to all of these requirements.

Here are just a few examples of columbium steel's wide versatility. Line pipe for gas and oil offers ease of manufacture with excellent physical strength. Trucks, automobiles, farm implements, trailers and railroad cars take advantage of strength and ease of formability. Pressure vessels utilize the deep-drawing qualities of the steel. These applications and many others tell the story of columbium steel's versatility—and all with fewer rejects.

In the face of mounting manufacturing costs, columbium steels offer hope of effecting economies in producing your products. Ask any steel company for they can make it. Or ask us—we have a wide experience in its uses and knowledge of its manufacture.

MOLYBDENUM

4 Gateway Center CORPORATION OF AMERICA **Pittsburgh 22, Pa.**

Offices: Pittsburgh, Chicago, Los Angeles, New York, San Francisco
Sales Representatives: Brumley-Donaldson Co., Los Angeles, San Francisco
Subsidiary: Cleveland-Tungsten, Inc., Cleveland
Plants: Washington, Pa., York, Pa.

"THIS GEAR WILL GIVE MY DRIVE HIGHER SPEED PLUS LONGER LIFE..."

Utilizing the modern facilities in our newly equipped plant, higher speed and longer life are just two of the advantages that you will get with Philadelphia's revolutionary precision grinding technique. Very often these advantages are available at no more initial cost than conventional gearing.

HIGHER SPEEDS

Dynamic load factors are materially reduced. Your equipment can operate at higher speeds with increased load carrying capacity.

LONGER LIFE

Extreme accuracy of profiles, profile spacing and surface finish eliminates "running-in" periods and resulting wear.

REDUCED NOISE AND VIBRATION

Reduced tooth to tooth errors, accumulated pitch errors, and total composite errors give smoother contact . . . reduce noise and vibration.

REDUCED BACKLASH

Precision ground gearing means reduced backlash for reversing drives . . . plus uniform backlash where precision of movement is important.

100% INTERCHANGEABILITY

Duplicate units or spares can be installed with original manufacturing tolerances duplicated exactly.

FOR MORE INFORMATION

. . . investigate this modern technique. Send for our new bulletin, AN ADVANCED CONCEPT IN MODERN GEARS.

phillie gear®

PHILADELPHIA GEAR CORPORATION

King of Prussia (Suburban Philadelphia), Pennsylvania

New Selector Is Guide to 1100 Metals and Alloys

Want to know what metals to use for a job? Looking for an alloy to upgrade your product, or to meet special requirements? The 1960 edition of STEEL's award winning series of Metal Selectors is tailored to help you handle those problems and more

THE METALS PRODUCING INDUSTRY is on the move.

You'll find ample proof of that in STEEL's 1960 Metal Selector. (It starts opposite Page 126.) Based on replies from nearly 100 producers of metals and alloys, close to 1000 changes were incorporated in this new edition.

Many of the revisions are in the section on vacuum melted metals. They include new producers of alloys and new analyses listed for the first time. Other sections where many changes had to be made: High strength steels, special wrought copper alloys, high temperature steels.

● **Progress**—New equipment and wider experience with the vacuum melting process caused the expansion of listings in this section. This year, nearly all corrosion and heat resisting alloys can be obtained as vacuum melted materials.

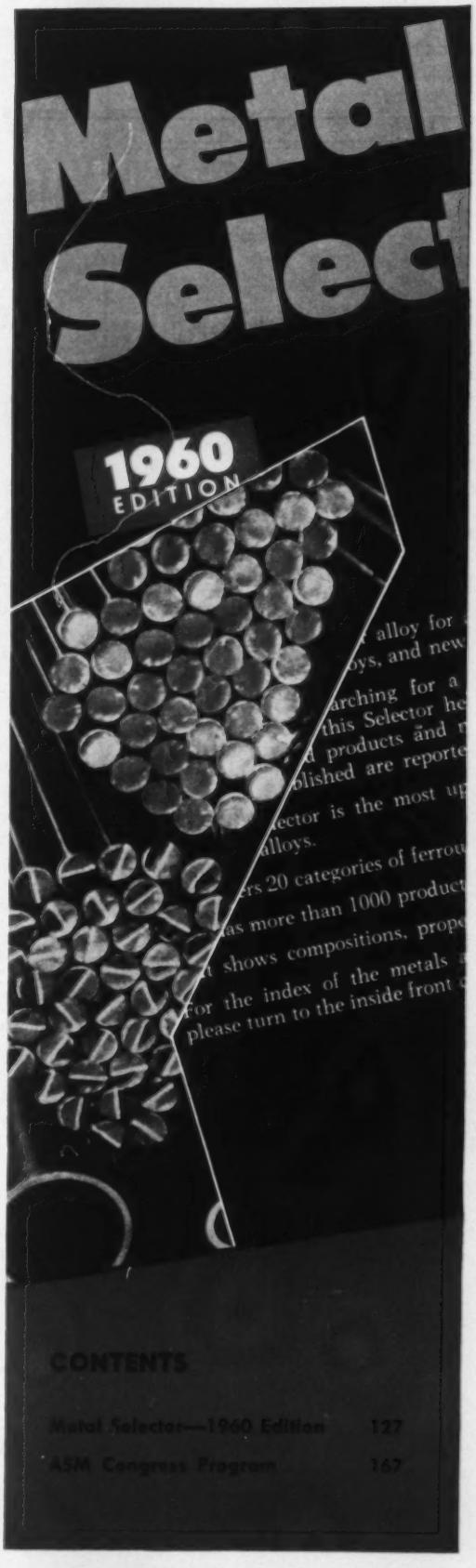
More producers are offering vacuum processed compositions, although the number available for off-the-shelf shipment is still limited.

The section on special wrought copper alloys has been completely revised, to permit the inclusion of more listings.

In this field, short runs and special analyses made primarily for one customer are commonplace. It is usual to consider the proposed application, then specify an alloy with the best combination of properties. The most popular compositions will usually show the greatest number of producers in the "Key to Source" column.

● **Explanation**—Overlapping could not be eliminated. Thus many of the stainless alloys are used for heat resisting applications as well. Some of those most frequently applied are also listed under the heat resisting alloys. And many are also supplied as vacuum melted.

The Selector does not carry a tool steel section. But



many tool steels have heat resisting properties, or are supplied as vacuum melted, so they are incorporated in these categories. And other tool steel grades can come under the superstrength category, where they are used as structural materials, rather than for tools or dies. There is a growing tendency for tool steel producers to supply physical property data on their products, in recognition of their wider uses.

The sections on alloy steels and H-steels have been revised to correspond with the AISI 1960 listings of the American Iron & Steel Institute.

There have been additions to the list of H-steels in the 4000 and 6000 series.

• **Among the Missing**—Not all the changes are additions, although they predominate. In the sections on vacuum melted metals, titanium, zirconium, ferrous castings, and others, some grades have been dropped.

• **Other Features**—Also new this year: Tantalum, columbium, some of their alloys, and some pure metals, such as vanadium, are in the vacuum melted section. Their production is based on arc or electron beam melting. The materials are costly and frequently tough to work, but they have properties which make them valuable in nuclear or aerospace applications. While production of such alloys is low when compared with that of steel (producers report output in pounds rather than tons), several hundred thousand pounds of these metals will be produced this year.

Growing interest in weight saving via the use of low alloy, high tensile strength steels is indicated by the increasing number of suppliers and the growing list of analyses produced. Some of the alloys are used as supplied; others require heat treatment to get the properties listed. The two groups have not been listed separately, but those requiring heat treatment are identified in the tabulation.

"With Our New Rules, The 1960 Metal Show Will Be a Mecca of Metals Information."

William A. Pennington,
professor of metallurgy, University of Maryland, to be new president, American Society for Metals

"SLIGHTLY SMALLER BUT BETTER than ever before . . ." could be the theme of the 42nd National Metal Congress & Exposition at Philadelphia, Oct. 17 to 21.

This year's show will be the world's best single source of information on metals because new regulations limit exhibitions to metals, metal processing, and metal design. This year's show confines exhibitors to 11 major categories:

Ferrous metals; nonferrous metals; related engineering materials; nuclear materials; tool materials (including cutting off and forming equipment); industrial heating equipment and supplies; cleaning and finishing equipment and supplies; welding and joining equipment and supplies; testing, inspection, and control equipment and supplies; metals production and casting equipment and supplies; parts, forms, and shapes for design and application.

Big change in the exhibitors' list this year, and reason for the presence of the many steel experts: Major primary metal producers will have displays. Co-operation of the American Society for Metals, sponsor of the show, and the American Iron & Steel Institute, helped in bringing steelmakers into the show. The Steelmark, identifying symbol for the industry, will be featured.

To metalworking managers, the show "will spotlight the need for improved technology as the major means for improving America's competitive position," says Allen Ray Putnam, ASM managing director. Noting that we face "an increasingly serious challenge from foreign competition, both here and in world markets," he states, "technological superiority has become the prime criterion for survival."

The highlight of the exhibit will be the Steel Arena, a concentration of exhibits staffed by 200 experts in steel engineering and production. The arena will house a variety of both common and the spectacular applications for steel, the work-horse metal.

During the show, visitors also will have the chance to listen to specialists present 250 technical papers and symposiums on metals and their applications.

EXTRA COPIES AVAILABLE

For a free, personal copy of the 1960 Metal Selector, write Editorial Service, STEEL, Penton Bldg., Cleveland 13, Ohio. For two to ten copies, the price is 25 cents a copy. A discount of 20 per cent will be given on larger quantities.

STEEL
OCTOBER 10, 1960

Metal Selector

1960 EDITION

Finding the right metal or alloy for a job can be a challenging task. There are many established alloys, and new ones are being introduced all the time.

Whether you are searching for a metal or trying to narrow down the choices, you'll find this Selector helpful. It is a continuing service to our readers. Improved products and new ones made available since our 1959 Selector was published are reported in this edition.

The 1960 Selector is the most up to date single source of information on metals and alloys.

- It covers 20 categories of ferrous and nonferrous metals.
- It has more than 1000 product listings.
- It shows compositions, properties, and applications of metals and alloys.

For the index of the metals and alloys included in this 32 page Selector, please turn to the inside front cover of this section.

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VACUUM MELTED METALS

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
NICKEL-BASE ALLOYS			
Udimet 500 Unitemp 500 Hastelloy Alloy 500	2, 5, 8, 13, 22 4* 3	C 0.10; Cr 19.00; Mo 4.00; Ti 3.00; Al 3.00; Co 19.00; B 0.001-0.010; Ni bal	Applications where high strength at high temperature is required. Jet engine and gas turbine buckets, discs, and bolts. Sheet and bar forms.
Udimet 700	5, 22	C 0.15; Cr 17.00; Mo 4.00; Ti 4.00; Al 4.00; Co 18.00; B 0.005-0.050; Ni bal	Strongest wrought alloy available for applications from 1500-2000° F.
713C Alloy; Inconel 713C; Haynes 713C	3‡, 5, 19, 21‡, 22	Cr 12.00; Mo 4.50; Cb 2.00; Al 6.00; Ti 0.50; Ni bal	Jet engine blades, buckets, discs, shafts.
901 Alloy; Incoloy 901; Altemp 1251; Udimet 200	1**, 4*, 5, 6, 7**, 9**, 11**, 12**, 13, 14*, 19, 21**	C 0.10 max; Cr 12.50; Ni 42.50; Mo 6.00; Ti 2.60; B 0.01-0.05	High stress rupture strength with excellent ductility at 1200° F, for jet engine wheels and rings.
J-1500	2, 19	C 0.15; Cr 20.00; Co 10.00; Mo 10.00; Ti 3.00; Al 1.00; Ni bal	Exceptionally high strength in 1000-1600° F range. Good ductility and forgeability; for turbine buckets and jet engine components.
J-1530	2, 19	C 0.08; Cr 19.50; Ni 57.00; Mo 4.30; Co 13.50; Al 1.30; Ti 3.10	Blades or high temperature parts for gas turbines.
J-1600	2, 19	C 0.10; Cr 19.00; Mo 4.00; Ti 3.00; Co 19.00; Al 3.00; Ni bal	High temperature areas in jet engines, gas turbines.
Waspalloy	1*, 2, 3, 4†, 5, 6, 8, 11†, 13, 14, 19, 22	C 0.08; Cr 19.50; Ni 57.00; Mo 4.30; Co 13.50; Fe 1.25; Zr 0.06; B 0.002-0.10; Al & Ti vary with grades	High stress rupture and endurance limit. Good ductility. Blades for turbojet engines; jet engine turbine and compressor wheels, spacers, etc.
GMR-235	2, 3‡, 4†, 5, 6, 8, 11†, 19	C 0.15; Cr 16.00; Mo 5.30; Al 3.20; Ti 2.20; Fe 10.00; B 0.07; Ni bal	Good ductility and high rupture strength. Used in investment cast turbine blades, vanes, wheels.
GMR-235D	3‡, 4‡, 5, 8, 19	C 0.15; Cr 15.50; Mo 5.25; Al 3.60; Ti 2.50; Fe 4.25; B 0.07; Ni bal	Higher rupture strength than GMR-235. Used for same type of components.
Hastelloy Alloy R-235 Unitemp R-235	3 4*	C 0.16 max; Mn 1.00 max; Si 1.00 max; Al 2.00; Ti 2.50; Fe 10.00; Mo 5.50; Cr 15.50; Co 2.25 max; Ni bal	High temperature alloy for jet engine combustion cans, afterburners, blading, etc.
Hastelloy Alloy F	3	C 0.02 max; Mn 1.50; Si 1.00 max; Cb + Ta 1.75-2.50; Ta 0.50 min; Fe 15.00; Ni bal	Corrosion resistant to both acid and alkaline solutions. Used in sulfite pulp digesters for paper.
Hastelloy Alloy X	3, 4*	C 0.15; Cr 22.00; Mo 9.00; Fe 19.00; Ni bal	Flange rings in hot end of jet engines.
D-979	1**	C 0.01; Cr 14.00; Ni 45.00; Mo 4.00; W 4.00; Ti 4.00; Al 1.00; B 0.01	Used in jet engines for stresses to 1600° F. Good workability.
AF 1753 Unitemp 1753	4†, 6, 22	C 0.25; Cr 16.50; W 8.50; Mo 1.50; Co 7.50; Ti 3.15; Al 2.00; B 0.006; Zr 0.05; Fe 9.50; Ni bal	High temperature alloy with good hot workability.
Nicrotung	10	C 0.10; Cr 12.00; Co 10.00; B 0.05; Zr 0.05; W 8.00; Al 4.90; Ti 4.00; Ni bal	Highly stressed parts at 1500-1800° F. Good room temperature tensile strength, ductility, castability, and oxidation resistance for gas turbine nozzle vanes and buckets.
Rene 41; Haynes R41; Altemp R41; Udimet R41	1†, 2, 3, 4†, 5, 6, 8, 11†, 13, 14, 19, 22	C 0.09; Cr 19.00; Co 11.00; Mo 9.75; Ti 3.15; Al 1.50; B 0.005; Fe 2.50; Ni bal	Good oxidation and corrosion resistance; high strength at 1600-1800° F. One of the strongest materials that can be successfully formed and welded. Jet engine components.
Refractaloy 26	4*, 10**	C 0.03; Cr 18.00; Ni 38.00; Mo 3.20; Co 20.00; Ti 2.60; Al 0.20	Jet engine and gas turbine buckets, discs, bolts, etc.
K-42-B	4*, 10**	C 0.03; Cr 18.00; Ni 42.00; Co 22.00; Ti 2.10; Al 0.20; Fe bal	Jet engine and gas turbine buckets, discs, bolts, etc.
M-252	1*, 2, 3, 4*, 5, 6, 8, 11†, 13, 14, 19, 22	C 0.15; Cr 19.00; Ni 56.50; Mo 9.75; Co 10.00; Al 1.10; Ti 2.50; Fe 1.25; B 0.005	High stress rupture and endurance limit with better ductility than air melted alloys. Jet engine and gas turbine buckets, discs, bolts, and other hot area parts.
Viscotherm	5	Cr, Co, Al, Ti	Used in glass manufacturing. Especially suited for critical 900-1300° F operations for molds, plungers, conveyors, etc.
IRON-BASE ALLOYS			
A-286	1**, 4*, 5, 6, 7**, 9**, 11**, 12**, 13**, 14*, 15**, 17**, 18**, 19	C 0.06; Mn 1.50; Si 0.70; Cr 14.80; Ni 25.50; Mo 1.30; Ti 2.00; Fe 53.50; V 0.30; B 0.003; Al 0.20	High stress rupture and endurance limit; good transverse ductility. Wheels for turbojet engines, turbine case applications, afterburner nozzles, aircraft fasteners. Excellent hot workability of large cross sections.
AISI 51100	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 12, 14*, 15**, 18**	C 1.00; Mn 0.35; P 0.025; S 0.025; Si 0.27; Cr 1.00; Fe bal	Bearing material. Low nonmetallic content, high fatigue strength, low frictional torque. Jet engine bearings.
AISI 52100	1*, 2, 4*, 5, 6, 7*, 9**, 10, 11**, 12**, 13**, 14*, 15**, 18**	C 1.00; Mn 0.35; P 0.025; S 0.025; Si 0.27; Cr 1.50; Fe bal	Bearing material. Properties similar to 51100 alloy
Discaloy	1**, 4*, 5, 10, 12**, 13**, 17**, 18**	C 0.06; Mn 0.80; Cr 13.50; Ni 26.00; Mo 3.00; Ti 1.67; Fe 54.00; Al 0.20; B 0.007	High hot stress rupture and endurance limit; good ductility; wheels for turbojet engines.
W-545	10**, 12	C 0.08; Mn 1.50; Si 0.40; Cr 13.50; Ni 26.00; Mo 1.50; Ti 2.85; Al 0.20; B 0.03; Fe bal	High strength bar and forging material for use up to 1350° F. Large forgings, rings, and complex shafts; highly stressed parts in missiles and turbines; low temperature use in retaining rings and electrical apparatus.

(Continued on Page S-61)

VACUUM MELTED METALS (continued)

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
D-6C; D6AC	1*, 4*, 6*, 7*, 9**, 11**, 12**, 13**, 14*, 15**	C 0.46; Mn 0.75; Si 0.25; Cr 1.05; Ni 0.55; Mo 1.00; V 0.08 max	Ultrahigh strength steel; pressure vessels, structural parts, airframe components
300-M	1*, 4*, 6, 7*, 9**, 12, 14*, 15**	C 0.45; Mn 0.80; Si 1.60; Cr 0.80; Ni 1.80; Mo 0.40; V 0.07	Ultrahigh strength steel, pressure vessels, structural parts, airframe components
M-308 (J1300)	1*, 2, 4†, 5, 6, 11†, 17**, 19, 22	C 0.08 max; Cr 14.00; Ni 33.00; Mo 3.60-4.60, Al 0.25; Zr 0.25; W 6.50; Ti 2.00; B 0.004; Fe bal	Precipitation hardening bar and forging material for uses at temperatures up to 1350° F.
AMS 6427	1*, 6, 11**, 12, 15**	C 0.30; Mn 0.90; Si 0.28; Cr 0.90; Ni 1.90; Mo 0.45; V 0.07	Superstrength structural parts, airframe components.
AMS 6434 (AISI 4335+V)	1*, 6, 7*, 11**, 12, 14†, 15	C 0.36; Mn 0.75; Si 0.50; Cr 0.80; Ni 1.80; Mo 0.35; V 0.20	Ultrahigh strength steel; pressure vessels.
Unitemp 212	4*†	C 0.08; Cr 16.00; Ni 25.00; Cb 0.50; Ti 4.00; Al 0.35; B 0.05; Zr 0.05; Fe bal	Jet engine parts.
V-57	1*, 4, 5, 6, 9**, 11**, 12**, 13**, 14*, 15*, 19, 22	C 0.08 max; Mn 0.25 max; Si 0.56; Cr 14.75; Ni 25.50; Mo 1.25; Ti 3.00; Al 0.25; B 0.0075; V 0.30; Fe bal	High stress rupture and endurance limit; good transverse ductility. Wheels for turbojet engines, turbine cases, afterburner nozzles, aircraft fasteners.
HS 220 (AMS 6407)	11**, 12, 15**, 18**	C 0.30; Mn 0.70; Si 0.60; Ni 2.05; Cr 1.20; Mo 0.45	Ultrastrength steel for aircraft uses; tensile strength to 240,000 psi.
HS 260	15**, 18**	C 0.40; Mn 0.70; Si 0.60; Cr 1.20; Ni 2.05; Mo 0.45	Ultrastrength steel for aircraft uses; tensile strength to 280,000 psi.
SAE 4340 AISI 4340	1*, 2, 4*, 5, 6, 7*, 9**, 10, 11**, 12**, 13**, 14**, 15**, 18**	C 0.40; Mn 0.70; P 0.04; S 0.04; Si 0.30; Ni 1.80; Cr 0.80; Mo 0.25; Fe bal	Superstrength structural parts, airframe components, high strength gears.
Crucible 56	6	C 0.40; Mn 0.55; Si 1.00; Cr 3.25; Mo 2.50; V 0.33	Ultrahigh strength material for use up to 1100° F.
5CrMoV Aircraft Steel VascoJet 1000, Pyromet 882, Crucible 218, Potomac A, Dynaflex, Unimach #1, Astro 1, Mldvac H-11	(Mod. H-11) 1*, 4*, 6, 7*, 9**, 12, 13**, 14*, 15	C 0.40; Cr 5.00; Si 0.90; Mo 1.30; V 0.50; Fe bal	Ultrahigh strength material for use up to 1000° F.
Unimach #2	4*	C 0.50; Si 1.00; Cr 5.00; Mo 1.40; V 1.00; Ni 1.50	Structural steel for high temperature service.
AISI 6150 SAE 6150	1*, 2, 4*, 5, 6, 7*, 11**, 12**, 14*, 15**, 18**	C 0.52; Mn 0.80; Si 0.30; Cr 0.95; Fe 97.50; V 0.21	High endurance limit, low nonmetallic inclusions. Aircraft valve springs, fasteners.
AMS-6260E AISI 9310 SAE 9310	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*, 15**, 18**	C 0.10, Ni 3.20; Cr 1.20; Mn 0.55; Si 0.25; Mo 0.12	Gear alloy, for critical aircraft gears.
AMS 6264C SAE 9317	1*, 4*, 5, 7*, 11**, 12**, 14*, 15**, 18**	C 0.16; Ni 3.25; Cr 1.20; Mn 0.55; Mo 0.12	High strength steel.
AMS 6470	13**	C 0.37; Cr 5.25; Mo 1.30; Si 1.00; V 0.50	Ultrahigh strength material; tensile strength to 290,000 psi.

ALLOY TOOL STEELS

AISI A-2 Air Hard	1*, 4, 6, 7*, 9**, 11**, 13**, 14*, 18**	C 1.00; Mn 0.60; Si 0.20; Cr 5.25; Mo 1.10; Fe 91.50; V 0.25	High temperature alloy for gages and rolls.
AISI D-2 Vacumeltrol 610, Ohio Die, Ferrovac	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*	C 1.50; Si 0.30; Mn 0.30; Cr 12.00; V 0.90; Mo 0.80; Fe bal	Nondeforming, cold work, die steel suitable for gages, thread rolling dies, drawing dies, coining dies, and rolls.
AISI D-4	1*, 2, 5, 6, 7**, 11**, 12**	C 2.20; Cr 12.00; Mo 1.00	Similar to D-2 but with greater wear resistance.
AISI H-11 Thermold A, Extrad, Hotform "V," Astro 1, Halcomb 218	2, 4*, 5, 6, 9**, 11**, 12**, 13**, 14*, 15**, 18**	C 0.35; Mn 0.30; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	Hot work die steel for thread rolling dies, gages, rolls. Superstrength structural parts, airframe components.
AISI H-13 (VDC) Potomac M	1*, 9**, 13**, 14*, 18**	C 0.40; Si 1.00; Mn 0.30; Cr 5.25; Mo 1.25; V 1.00	High strength steel for aircraft structural applications.
AISI M-1	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*, 18**	C 0.78; Mn 0.30; Si 0.30; V 1.15; Cr 3.75; Mo 8.55; Fe 83.50; W 1.60;	Tool steel for high temperature bearings.
AISI M-2	1*, 2, 4*, 5, 6, 7*, 9**, 11*, 12**, 13**, 14*, 18**	C 0.83; W 6.00; Cr 4.00; V 2.00; Mo 5.00; Fe bal	High speed steel suitable for high temperature bearings, taps, drills, chasers, broaches, milling cutters, etc.
AISI M-10	1*, 2, 4, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*, 18**	C 0.87; Mn 0.30; Si 0.30; Cr 4.00; Mn 7.90; Fe 84.50; V 2.00	High speed steel suitable for high temperature bearings, taps, drills, chasers, broaches, milling cutters, etc.
HTB-1 MHT	1*, 6, 7*, 14*, 18**	C 1.03; Mn 0.35; Cr 1.45; Al 1.00	High temperature bearings for jet engines.
AISI M-50 (HTB-2) BHT	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*, 18**	C 0.80; Mn 0.30; Si 0.20; Mo 4.25; V 1.00; Cr 4.00; Fe bal	Bearings, hot work die steel.
HTB-3 Halmo Virgo	1*, 2, 4*, 6, 9**, 11**, 18**	C 0.57; Mn 0.30; Si 1.15; Cr 4.75; Mo 5.25; V 0.55	Jet engine and other high temperature applications.
AISI T-1	1*, 4, 5, 6, 7*, 9**, 11**, 12**, 13**, 14*	Cr 4.00; W 18.00; V 1.10; C 0.75; Fe bal	Tool steel for high temperature bearings.
AISI T-15	1, 2, 4*, 5, 7*, 9**, 13**	C 1.50; W 13.00; Cr 4.20; V 5.00; Cr 5.00; Fe bal	High speed steel with good wear resistance. Used for high temperature bearings, cutting and forming tools.
Rex Super Cut	6	C 0.80; Cr 4.00; V 2.00; W 18.50; Mo 0.60; Co 8.00	Tool steel for high temperature bearings.
Teton	1*	C 1.00; Cr 1.50	High compressive strength and abrasion resistance; ball and roller bearings, spindles, and arbors.
AISI 7140	15	C 0.40; Mn 0.60; Si 0.30 Al 1.15; Cr 1.60; Mo 0.35	Nitriding steel.

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
COBALT-BASE ALLOYS			
J-1570	2, 3, 4*, 6, 19	C 0.20; Cr 20.00; Ni 28.00; Co 37.50; Ti 4.50; Fe 1.40; W 6.00	Blades or high temperature parts for gas turbines.
J-1650	2, 19	C 0.20; B 0.02; Ni 27.00; Cr 19.00; Ta 2.00; W 12.00; Ti 3.80; Co bal	One of strongest wrought alloys commercially available.
Haynes Alloy No. 31 (X-40)	2, 3, 5, 8	Ni 10.00; Fe 1.00 max; Cr 23.00; W 7.00	High temperature areas in jet engines.
Altemp S-816 (AMS 5765A)	1, 4, 5, 6, 11**, 14	Co 43.00; Cr 20.00; Ni 20.00; Mn 1.50; Mo 4.00; W 4.00; Cb + Ta 4.00; C 0.38	High temperature alloy.
HIGH TEMPERATURE ALLOYS			
AISI 304	1*, 11**, 12, 14*, 15**	C 0.08 max; Mn 2.00 max; Cr 18.50; Ni 9.5	High temperature service, corrosive conditions.
AISI 305	1*, 11**, 12, 14*, 15**	C 0.12 max; Mn 2.00 max; Cr 18.00; Ni 11.5	High temperature service, corrosive conditions.
AISI 310	1*, 4*, 5, 6, 8, 11**, 12**, 14*, 15**, 18**	C 0.25 max; Cr 25.00; Ni 20.50; Fe bal	High temperature service under corrosive conditions.
AISI 316	1*, 4*, 5, 6, 7*, 11**, 12, 14*, 15**, 18**	C 0.08; Cr 17.00; Ni 12.00; Mo 2.50	High resistance to corrosives affecting other stainless steels; high creep resistance.
AISI 316L	1*, 4*, 5, 6, 7*, 11**, 12, 14*, 15**	C 0.03 max; Cr 17.00; Ni 12.00; Mo 2.50	Resistant to intergranular corrosion after welding or stress relieving.
AISI 347	1*, 2, 4*, 5, 6, 11**, 12**, 14*, 15**, 18**	C 0.08; Mn 1.90; Cr 18.00; Ni 9.90; Cb + Ta 0.90; Fe bal	Crack-free core wire for welding and miscellaneous uses. Jet engine parts in cyclical heat zone.
AISI 403	1*, 4*, 5, 6, 7*, 9**, 11**, 12, 14*, 15**	C 0.15 max; Cr 12.20; Si 0.50 max; Mn 1.00 max	Steam and gas turbine parts.
AISI 410 (AMS 5350C)	1*, 4*, 5, 6, 7*, 8, 9**, 11**, 12**, 14*, 15**, 18**	C 0.15 max; Mn 1.00 max; Si 1.00 max; Cr 11.50-13.50; Ni 0.50 max; Fe bal	General purpose corrosion and heat resisting chromium steel.
Turbine Alloy (Type 422) Crucible 422, Carpenter 636, Unitemp 1420WM	1*, 4*, 6, 7*, 9**, 11**, 12**, 14*, 15**	C 0.20; W 1.00; Cr 13.00; Mo 1.00; Ni 0.75; V 0.40; Fe bal	Hardenable chromium steel; corrosion resistant.
AISI 430	1*, 6, 7*, 9**, 11**, 14*, 15**	C 0.12 max; Mn 1.00 max; Si 1.00 max; Cr 16.00	Oil burner rings.
AISI 431	1*, 4*, 5, 6, 7*, 11**, 12**, 14*, 15**	C 0.20 max; Cr 16.00; Ni 1.80	For heat treatment to high mechanical properties. Corrosion resistant.
AISI 440B	1*, 4*, 5, 6, 7*, 11**, 13*, 15**, 18**	C 0.85; Cr 17.00; Mn 0.50	Hardenable chromium steel; corrosion resistant.
AISI 440C	1*, 2, 4*, 5, 6, 7*, 9**, 11**, 13*, 14, 15**, 18**	C 1.05; Mn 0.375; Si 0.375; Cr 17.25; Mo 0.50; Fe 80.50	Stainless instrument bearings. Fine finish and high strength rolls.
AISI 440C Modified	7*, 9*, 11**, 14**	C 1.05; Mn 0.60; Si 0.35 max; Cr 14.00; Mo 4.00	Instrument bearings, high strength rolls.
Greek Ascoloy Unitemp 1415NW, 418 Special	1*, 4*, 7*, 9**, 11**, 13*, 14*, 15**, 18**	C 0.18; Cr 13.00; W 3.00; Ni 2.00; Fe bal	Heat resisting steel for jet engine compressor blades, turbine discs and auxiliary parts.
Unitemp N-155, Altemp 155	1*, 4*, 13**, 14*	C 0.15; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; Cb + Ta 1.00; N 0.13; Fe bal	High strength to 1500° F; oxidation resistant to 1800° F. Jet engine tail pipes and afterburners, combustion chambers, nozzle assemblies, bolts, buckets, discs.
AM 350	1*, 4*	C 0.09; Mn 0.75; Si 0.35; Cr 16.65; Ni 4.50; Mo 2.85; N 0.10; Fe bal	Hardenable stainless grade. High strength corrosion and heat resisting.
AM 355	1**, 4*	C 0.13; Mn 0.75; Si 0.35; Cr 15.50; Ni 4.50; Mo 2.85; N 0.10; Fe bal	Similar to Unitemp 350.
Armco 17-4 PH	8, 12**, 15	C 0.07 max; Mn 1.00; Si 1.00; Cr 16.50; Ni 4.00; Mo 0.50 max; P 0.04 max; S 0.03 max; Cu 4.00; Cb 0.35; Fe bal	Castings for high strength, corrosion and heat resistance.
Lapelloy, Unitemp 1430MV	1**, 4*, 9**, 12, 14*, 15**, 18**	C 0.30; Cr 11.50; Mo 2.75; Ni 0.35; V 0.25; Fe bal	Gas turbine compressor discs and parts. Flange rings.
Lapelloy "C"	12, 14*	C 0.20; Mn 0.65-1.00; Si 0.50 max; Cr 11.00-12.00; Ni 0.50 max; Mo 2.50-3.00; P 0.03 max; S 0.03 max; Cu 1.75-2.25; N 0.06-0.10	Similar to Lapelloy but with greater ductility and impact strength.
Carpenter H-46 Midvac H-46	12, 14*	C 0.15; Mn 0.57; Si 0.40; Cr 11.50; Mo 0.45; Cb 0.25; V 0.30; Fe bal	Outstanding resistance to stress corrosion cracking and oxidation. Steam and gas turbine buckets, compressor blades, discs, and bolts.
Carpenter 404	14*	C 0.05; Mn 1.00; Si 0.50; Cr 11.00-12.50; Ni 1.25-2.00; N 0.03 max	Highly stressed parts at temperatures up to 1050° F where joining is a problem.
Inductovac MCS	4*	C 0.70; Si 1.05; Cr 3.50; Mo 5.50	High temperature bearings.
TBS-600	18**	C 0.95-1.10; Mn 0.60-0.80; P 0.025 max; S 0.025 max; Si 0.85-1.20; Cr 1.25-1.65; Mo 0.25-0.35	Bearing steel for high hardness and wear resistance to 600° F.
CBS-600	18**	C 0.16-0.22; Mn 0.50-0.70; P 0.040 max; S 0.040 max; Si 0.90-1.25; Cr 1.25-1.65; Mo 0.90-1.10	Bearing steel for high hardness and wear resistance to 600° F.
Inductovac 18-8B, Ferrovac 304 B	4, 6	C 0.06; Cr 19.00; Ni 9.50; Fe 69.00; B 2.15	Atomic energy applications, such as neutron control rods.
Inductovac 18-15B	4	C 0.01; Mn 1.20; Cr 18.00; Ni 15.00; Fe 65.00; B 0.80	Atomic energy applications, such as neutron control rods.
19-9 DL	1*, 4*, 11**, 12, 14, 15**	C 0.32; Cr 18.50; Ni 9.00; Mo 1.40; W 1.35; Cb + Ta 0.40; Ti 0.25	High temperature use in jet engine, gas turbine and turbosuperchargers as rotors, buckets, bolts, manifolds, tail cones.
19-9 DX	1*, 4*, 11**, 12, 14, 15**	C 0.32; Cr 18.50; Ni 9.00; Mo 1.60; W 1.35; Ti 0.55	Cb-free alloy. Same as 19-9 DL.
VSM	14	C 0.70; Mn 0.50; Si 1.10; Cr 3.00; Mo 5.25	High hot hardness, resistant to wear and abrasion at elevated temperatures. Used for valve seat inserts and stems, slides, guides, spindles, bearings.

(Continued on Page S-6)

VACUUM MELTED ALLOYS (continued)

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
AMS-5382B PWA-651	6, 8	C 0.35-0.45; Mn 2.00-3.00; Si 1.00 max; Cr 25.50; Mo 2.00-4.00; Fe 5.00 max; W 7.50; S 0.03 max; Ni 10.50; Co bal	Castings for high temperature aircraft service.
Silmo-Vac	7*	C 0.58; Mo 5.00; Cr 4.75; Mn 0.30; V 0.55; S 1.10; Fe bal	High temperature bearings.

MISCELLANEOUS ALLOYS

Vicalloy	7	Mn 0.70; V 9; Fe 38.10; Co bal	Permanent magnet alloy.
Magnetic Alloy	8, 10	C 0.75; W 5.00; Si 0.20-0.35; Cr 4.00; Co 0.39; Fe bal	Castings and wrought forms for magnetic applications.
Polar	19	Modified 1020 steel	Magnetron pole pieces and special applications requiring vacuumtight seal.
Alnico	2, 6, 19	Co, Ni, Al, Fe	Permanent magnets for high energy, high quality applications.
Core Iron	14	C 0.06 max; Mn 0.20 max; Si 0.25 max; V 0.10 max; Fe bal	For direct current magnetic applications in solenoids, armatures, and assemblies subject to high vacuum. Free from magnetic aging.
Kovar	10, 23	Co 17.00; Ni 29.00; Fe 54.00	Glass sealing alloy.
Nicoseal	14		
Nitron 52	16	Ni 51; Fe bal	Glass sealing alloy.
Nicromet 46	16	Ni 46; Fe bal	Glass sealing alloy.
Ceramiseal	16	Fe; Ni; Co	Sealing to high alumina alloys.
Vanadium	17	V	High ductility for nuclear cladding.
Nichrome V DEF 642	20	Ni 78; Cr 19.5; Cb 1.05; Si 1.25	High temperature brazing belts, resistance furnace elements.
Thermenol	1, 4, 6	C 0.03; Mo 3.30; Al 15.40; Fe 81.27	Magnetic and heat resistant uses.
Alfenol	4, 6, 14	C 0.01; Al 15.85; Fe 84.00	Magnetic and heat resistant uses.
HyMu "800"	14	C 0.05; Mn 0.50; Si 0.15; Ni 79.00; Mo 4.00; Fe bal	For transformer cores, tape wound toroids and laminations where compactness and weight factors are important.
Cuprovac E	2, 6	99.98+ per cent copper	High purity, low gas content; low nonmetallics, low high vapor pressure elements. Vacuum tubes, transmitting tubes, magnetrons.
Nivac P	2, 6	99.92+ per cent nickel	Properties similar to above. Vacuum tubes, hydrogen thyratrons, magnetrons, etc.
Ferrovac E	2, 6	99.92+ per cent iron	Properties similar to above. Magnetic alloys, vacuum tubes, magnetrons, klystrons, etc.
Ferrovac 49-2V Supermendur	6 10	Co 49.00; Fe 49.00; V 2.00	High saturation, high permeability magnetic alloy.
Ferrovac 50% Ni Hipernik	6 10	Ni 50.00; Fe 50.00	High permeability, low coercive force magnetic alloy.
Ferrovac 42% Ni	6	Ni 42.00; Fe 58.00	High permeability, low coercive force magnetic alloy.
Ferrovac Type 304	6	C 0.08 max; Mn 2.00 max; Si 1.00 max; Ni 8.00-12.00; Cr 18.00-20.00	Electronic tubes.
Rodar	16	Ni 29.00; Co 17.00; Mn 0.30; Fe bal	Metal to glass sealing alloy.
Therlo	20		
Cathode Nickel	16, 20	Ni 99.00 (+ Co) min	Vacuum tube alloy.
32 Alloy	16	Cu 98.50 min; Ni 1.00; P 0.20	High conductivity, high strength alloy for vacuum tubes.
Karma	20	Ni 75.00; Cr 20.00 + Al, Fe	Fine resistance wire.
#240 Alloy	20	Ni 80.00; Cr 20.00	High purity resistance wire.
#70 Alloy	20	Ni 60.00; Cr 15.00; Fe bal	High purity resistance wire.
Molybdenum	4**	1. Pure 2. Mo + Ti 0.50	Jet engine parts.
2V Permendur	7	V 2; Co 49; Fe bal	Magnetic alloys for electrical apparatus.
Columbium-Zirconium	24	Zr 1.0; Cb bal	High temperature applications; liquid metal heat exchangers.
Cb-74	25	Zr 5.0; W 10.0; Cb bal	Tensile strength over 35,000 psi at 2200° F.
Cb-65	25	Ti 7.0; Zr 0.8; Cb bal	Can be cold rolled extensively; good notch toughness at subzero temperatures.
Cb-8Ti	25	Ti 8.0; Cb bal	Can be cold worked.
Columbium	24, 25, 27	Cb, commercially pure	Heat and corrosion resistant.
Tantalum	3, 24, 27	Ta, commercially pure	Refractory metal with good electrical and corrosion properties.
Tantalum-Tungsten	26, 27	Ta 90.0; W 10.0	Tensile strength over 7000 psi at 3500° F; more resistant to oxidation than pure Ta.

KEY TO SOURCE:

(1) Allegheny Ludlum Steel Corp., Pittsburgh.
(2) Metallurgical Products Dept., General Electric Co., Detroit.
(3) Haynes Stellite Co., division of Union Carbide Corp., Kokomo, Ind.
(4) Universal-Cyclops Steel Corp., Bridgeville, Pa.
(5) Metals Div., Kelsey-Hayes Co., New Hartford, N. Y.
(6) Crucible Steel Co. of America, Pittsburgh.
(7) Vanadium-Alloys Steel Co., Latrobe, Pa.
(8) Cannon-Muskegon Inc., Muskegon, Mich.
(9) Latrobe Steel Co., Latrobe, Pa.
(10) Westinghouse Electric Corp., Blairsville, Pa.
(11) Armetco Inc., Wooster, Ohio.
(12) Midvale-Heppenstall Co., Philadelphia.
(13) Firth Sterling Inc., Pittsburgh.
(14) Carpenter Steel Co., Reading, Pa.
(15) Republic Steel Corp., Cleveland.
(16) Wilbur B. Driver Co., Newark, N. J.
(17) Oregon Metallurgical Corp., Albany, Oreg.
(18) Timken Roller Bearing Co., Canton, Ohio.
(19) Allvac Metals Co., Monroe, N. C.
(20) Driver-Harris Co., Harrison, N. J.
(21) Huntington Alloy Products Div., International Nickel Co. Inc., New York.
(22) Kolcast Industries Div., Thompson Ramo Wooldridge Inc., Cleveland.
(23) Refractories Div., Carborundum Co., Latrobe, Pa.
(24) Wah Chang Corp., Albany, Oreg.
(25) Union Carbide Metals Co., Niagara Falls, N. Y.
(26) Metals Div., National Research Corp., Cambridge, Mass.
(27) Fansteel Metallurgical Corp., North Chicago, Ill.

*All alloys are induction vacuum melted unless source is marked with asterisk, which indicates a consumable electrode melted grade is also available.

**Indicates only consumable electrode melted grade is available.
†Research indicates that combination induction vacuum, consumable vacuum may be advisable for improved hot workability.
‡Indicates these alloys are made as cast products only.

PRODUCERS' NOTES:

1. All Firth Sterling induction vacuum melted materials are prefixed by the word "Stervac," and all consumable electrode melted materials are prefixed by "Stercon" and "Stercon H" (Hopkins process)
2. Driver-Harris Co. is a custom melter and will produce special alloys to customers' specifications.
3. Allvac Metals Co. also melts the AISI alloy steels, the low alloy steels for missile applications, and materials for nuclear uses.
4. Republic Steel Corp. will vacuum melt any standard AISI grade steel and titanium.
5. Armetco Inc., will produce evaluation and production lots of a variety of vacuum melted materials.
6. Oregon Metallurgical Corp. is also a source for vacuum melted commercially pure titanium, the 6Al-4V titanium alloy, reactor grade zirconium, Zircaloy II, Zircaloy III, tungsten base alloys, molybdenum base alloys columbium base alloys, and vanadium metal. All materials are available only in the consumable electrode vacuum melted grade.
7. Vanadium-Alloys Steel Co. induction vacuum melted materials are suffixed by "IVM." Consumable vacuum melted materials are suffixed by "CVM."
8. Allegheny Ludlum Steel Corp. produces a comprehensive list of alloys in high temperature, stainless, tool steel, and specialty grades. The company also vacuum melts zirconium, molybdenum, and similar metals.
9. Crucible Steel Co. of America has complete vacuum melting facilities for induction (VIM), arc remelt (VAR), and double melting (VIR). Any metal or alloy listed herein or others by special request will be considered for melting by any vacuum process.
10. All Latrobe Steel vacuum melted metals use the suffix VacArc.
11. U. S. Steel Corp. states it "will welcome inquiries for vacuum melted steels."

HIGH TEMPERATURE ALLOYS

TYPE: FERRITIC LOW ALLOYS AND STAINLESS ALLOYS

Alloy	Composition %	Properties and Applications
Crucible 422	C 0.22; Mn 0.65; Si 0.36; Cr 12.00; Ni 0.70; Mo 1.00; W 1.00; V 0.25	
Crucible 422-M	C 0.28; Mn 0.84; Si 0.25; Cr 12.00; Ni 0.20; Mo 2.25; W 1.70; V 0.50	
USS 12MoV	C 0.25; Mn 0.50; Si 0.50; Ni 0.50; Cr 12.00; Mo 1.00; V 0.30	
Carpenter H-46	C 0.15; Mn 0.57; Si 0.40; Cr 11.50; Mo 0.45; Cb 0.25; V 0.30	
Rex-448 (British)	C 0.15; Cr 11.50; Mo 0.45; Cb 0.45; V 0.15	Alloys are higher strength modifications of AISI standard 12% chromium, Type 403 stainless. Various grades are used for steam and gas turbine buckets, compressor blades, discs, and bolts. Outstanding resistance to stress-corrosion cracking and oxidation. Available in sheets for supersonic aircraft applications.
Unitemp 1409 Cb	C 0.16; Cr 12.75; Cb 0.42	
Greek Ascoloy	C 0.15; Cr 13.00; Ni 2.00; W 3.00	
Unitemp 1416 MV	C 0.15; Cr 12.25; Mo 1.00; V 0.25	
Moly Ascoloy	C 0.08; Cr 13.00; Mo 2.00	
Unitemp 1420 WM	C 0.20; Cr 13.00; Ni 0.75; W 1.00; Mo 0.95; V 0.35	
Lapelloy (Unitemp 1430 MV)	C 0.30; Cr 11.50; Ni 0.35; Mo 2.75; V 0.25	
H-40 (British)	C 0.23; Mn 0.30; Si 0.45; Cr 2.70	Gas turbine rotors, casings, castings, and other uses needing high creep strength up to 600° F.
ASTM A 213-60T Grade T2	C 0.10-0.20; Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.10-0.30; Cr 0.50-0.81; Mo 0.44-0.65	
Grade T3b	Si 0.50*; Cr 1.65-2.35; Mo 0.44-0.65	
Grade T5	Si 0.50*; Cr 4-6; Mo 0.45-0.65	
Grade T5b	Si 1-2; Cr 4-6; Mo 0.45-0.65	
Grade T5c	C 0.12*; Si 0.50*; Cr 4-6; Mo 0.45-0.65	Composition of all grades not otherwise listed includes C 0.15*; Mn 0.30-0.60; P 0.03*; S 0.03*. T5c has a Ti content not less than 4 x C, but less than 0.70. These grades and modifications are offered by several suppliers as tradename products for superheater tubing and oil refinery use for temperatures as high as 1200° F; lower alloy ranges are used for lower temperatures.
Grade T7	Si 0.50-1.00; Cr 6-8; Mo 0.45-0.65	
Grade T9	Si 0.25-1.00; Cr 8-10; Mo 0.90-1.10	
Grade T11	Si 0.50-1.00; Cr 1-1.50; Mo 0.44-0.65	
Grade T12	Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.50*; Cr 0.80-1.25; Mo 0.44-0.65	
Grade T17	C 0.15-0.25; Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.15-0.35; Cr 0.80-1.25; V 0.15	
Grade T21	Si 0.50*; Cr 2.65-3.35; Mo 0.80-1.06	
Grade T22	Si 0.50*; Cr 1.90-2.60; Mo 0.87-1.13	
Dynaflex	C 0.40; Si 0.90; Mn 0.30; Cr 5.00; V 0.50; Mo 1.30	Ultrahigh strength for service up to 1000° F; airframes, skins, fasteners, rivets, axles, rotors.
Dynacarb	C 0.12; Si 0.90; Mn 0.30; Cr 5.00; V 0.60; Mo 1.40	Low carbon version of H-11; carburizing steel for elevated temperature gear applications to 900° F.
Chromalloy (Unitemp 14CMV)	C 0.20; Cr 1.00; Mo 1.00; V 0.12	Sheet metal casing on aviation gas turbines.
Unitemp 14 HV	C 0.45; Cr 1.00; Mo 0.55; V 0.30	Same as above and steam and gas turbine bolting.
17-22A	C 0.44; Si 0.65; Cr 1.25; Mo 0.50; V 0.25	Same as above.
17-22AS (Unitemp 14 MV)	C 0.30; Mn 0.55; Si 0.65; Cr 1.25; Mo 0.50; V 0.25	Steam and gas turbine bolting up to 1050° F; sheet metal casing assemblies. Axial-flow compressor blading at 800° F. Aircraft brakes. Compressor discs.
17-22 AV (Unitemp 14 MHV)	C 0.30; Si 0.65; Cr 1.25; Mo 0.50; V 0.85	High vanadium modification of above.
Unimach I (Thermold A)	C 0.35; Mn 0.45; Si 1.00; Cr 5.00; Mo 1.40; V 0.45	Ultrahigh strength for service up to 1000° F. Airframes, skin, fasteners, rivets, axles, rotors.
Unimach II (Thermold B)	C 0.35; Mn 0.45; Si 1.00; Cr 5.00; Mo 1.70; W 1.35	Same as above for ultrahigh strength at 1000° F.
Thermold J	C 0.53; Mn 0.35; Si 1.00; Cr 5.00; Ni 1.50; Mo 1.75; V 1.00	Ultrahigh strength up te 1000° F. Tensile strength 230,000 psi at 1000° F; 75,000 psi at 1200° F.
Crucible 56	C 0.40; Mn 0.55; Si 1.00; Cr 3.25; Mo 2.50; V 0.33	Bars, wire, sheets, plates, and billets for reforging. Tensile strength 228,000 psi at 1000° F, 154,000 psi at 1100° F.
Thermenol	Mo 1.70; Al 16.00; V 0.30	Oxidation resistant sheet metal parts.
Crucible 218	C 0.40; Mn 0.35; Si 1.00; Cr 5.00; Mo 1.40; V 0.45	Aircraft sheets, forgings, and fittings for high strength and resistance to softening up to 1000° F.
Pyromet 882	C 0.40; Mn 0.35; Si 1.10; Cr 5.00; Mo 1.35; V 0.40	Ultrahigh strength for service up to 1000° F; airframes, skin, fasteners, rivets, axles, rotors, spindles, etc.
Nu-Die V (Crucible)	C 0.40; Si 1.05; Cr 5.00; Mo 1.35; V 1.10	Bars, wire, sheets, and billets for reforging.
Chro-Mow (Crucible)	C 0.32; Mn 0.35; Si 1.00; Cr 5.00; Mo 1.35; W 1.35; V 0.20	Same as Crucible 218.
HTB-1 (Allegheny Ludlum)	C 1.02; Mn 0.35; Si 0.40; Cr 1.45; Al 1.00; Fe 1.00	Aircraft sheet forgings and fittings for high strength and resistance to softening up to 1000° F.
HTB-2 (Allegheny Ludlum)	C 0.58; Mn 0.30; Si 1.15; Cr 4.75; Mo 5.25; V 0.55	Used in high temperature bearing applications, primarily jet engines.

(Continued on Page S-8)

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
Type: Ferritic Low Alloys and Stainless Alloys (continued)		
HTB-3 (Allegheny Ludlum)	C 0.57; Mn 0.30; Si 1.15; Cr 4.75; Mo 5.25; V 0.55	Used in high temperature bearing applications, primarily jet engines.
Teton (Allegheny Ludlum)	C 1.00; Cr 1.50	For high hardness and wear resistance to 600° F. Ball and roller bearings.
Potomac A (Allegheny Ludlum)	C 0.40; Mn 0.30; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	Aircraft sheets, forgings, and fittings for high strength and resistance to softening up to 1000° F.
Potomac M (Allegheny Ludlum)	C 0.40; Si 1.00; Cr 5.00; Mo 1.00; V 1.00	Similar to Potomac A.
HWD #1 (Firth Sterling)	C 0.35; Si 1.00; Cr 5.00; Mo 1.55; W 1.40; V 0.30	
Astro-1 (Firth Sterling)	C 0.37; Si 1.00; Cr 5.25; Mo 1.35; V 0.50	High temperature applications under 1000° F. Used mainly for structural parts requiring high strength and shock resistance.
HWD #3 (Firth Sterling)	C 0.40; Si 1.00; Cr 5.25; Mo 1.25; V 1.00	
TBS-600	C 0.95-1.10; Mn 0.60-0.80; Si 0.85-1.25; Cr 1.25-1.65; Mo 0.25-0.35; P 0.025*; S 0.025*	For high hardness and wear resistance to 600° F; ball and roller bearings.
CBS-600	C 0.16-0.22; Mn 0.50-0.70; Si 0.90-1.25; Cr 1.25-1.65; Mo 0.90-1.10; P 0.040*; S 0.040*	For high hardness and wear resistance to 600° F; ball and roller bearings.
VascoJet 1000 (Vanadium Alloys)	C 0.40; Mn 0.30; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	Ultrahigh strength for service up to 1000° F; airframes, skin, fasteners, rivets, axles, rotors, spindles, etc.
VascoJet (1000, 5 temper)	C 0.50; Mn 0.30; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	Tensile strength 300,000 to 325,000 psi.
Vasco X-4 (Vanadium Alloys)	C 0.40; Mn 0.30; Si 0.30; Cr 4.25; Co 4.25; Mo 0.40; W 4.25; V 2.10	Ultrahigh strength material.
Vasco X-8 (Vanadium Alloys)	C 0.47; Mn 0.30; Si 0.90; Cr 7.75; Mo 1.35; V 1.40	Ultrahigh strength material.
Vasco X-21 (Vanadium Alloys)	C 0.33; Mn 0.20; Si 0.30; Cr 3.50; W 9.75; V 0.45	Ultrahigh strength material.
Vasco Y-9 (Vanadium Alloys)	C 0.48; Mn 0.30; Si 0.90; Cr 3.25; Mo 1.45; V 0.25	Ultrahigh strength material.
Lapelloy C	C 0.20; Mn 0.65-1.00; Si 0.50*; Cr 11.00-12.00; Ni 0.50*; Mo 2.50-3.00; P 0.03*; S 0.03*; Cu 1.75-2.25; N 0.06-0.10	Similar to Lapelloy, but with greater ductility and impact strength.
Carpenter 404	C 0.05; Mn 1.00; Si 0.50; Cr 11.00-12.50; Ni 1.25-2.00; N 0.03*	Highly stressed parts at temperatures up to 1050° F where joining is a problem.
AISI 410	C 0.15; Mn 1.00; Si 1.00; Cr 11.50-13.00	Highly stressed parts at temperatures up to 1200° F.
AISI 431	C 0.12-0.17; Mn 1.00; Si 1.00; Cr 15.50-17.00; Ni 1.50-2.50	Excellent toughness at relatively high hardness levels at temperatures from —100 to 1200° F.
VSM	C 0.70; Mn 0.50; Si 1.10; Cr 3.00; Mo 5.25	Resistant to wear and abrasion at high temperatures. For valve seat inserts, stems, slides, guides, and bearings.
636 Alloy	C 0.20-0.25; Mn 1.00*; Si 1.00*; Cr 12.00-14.00; Ni 0.50-1.00; Mo 0.75-1.25; W 0.75-1.25; P 0.04*; S 0.03*; V 0.20-0.50	Buckets and blades in steam turbines; aircraft valves.
No. 709 #1	C 0.30; Mn 0.55; Si 0.65; Cr 1.25; Mo 0.50; P 0.025*; S 0.025*; V 0.25	Used in aircraft, steam turbines, valves, pressure vessels; jet engine components.
No. 709 #2	C 0.45; Mn 0.55; Si 0.25; Cr 1.00; Mo 0.55; P 0.025*; S 0.025*; V 0.30	Used in aircraft, steam turbines, valves, pressure vessels; jet engine components.
H-11 Firedie (Columbia)	C 0.37; Mn 0.35; Si 1.00; Cr 5.25; Mo 1.35; V 0.50	
H-12 Alcodie (Columbia)	C 0.35; Mn 0.35; Si 1.00; Cr 5.00; Mo 1.45; W 1.25; V 0.45	
H-13 Vanadium Firedie (Columbia)	C 0.38; Mn 0.35; Si 1.00; Cr 5.25; Mo 1.35; V 1.05	
H-21 Formite #2 (Columbia)	C 0.33; Mn 0.30; Cr 3.25; W 9.50; V 0.50	Bars, hot rolled and hammer forged; blocks, discs, and ring forgings.
H-24 Formite #3 (Columbia)	C 0.50; Mn 0.30; Cr 3.25; W 15.50; V 0.50	
H-26 Clarite HW (Columbia)	C 0.58; Mn 0.25; Cr 4.00; W 18.00; V 0.70	
H-43 Molite HWL (Columbia)	C 0.63; Mn 0.25; Cr 4.00; Mo 8.25; V 1.90	
Acmite L (Columbia)	C 0.50; Mn 0.25; Cr 4.00; Co 5.00; W 18.00; V 1.10	
Cobite L (Columbia)	C 0.49; Mn 0.30; Cr 4.25; Co 8.75; W 18.50; V 1.90	
J-1300 M308	C 0.08; Cr 14.00; Ni 33.00; Mo 4.00; W 6.50; Ti 2.00; Al 0.25; Zr 0.25	Austenitic grade for turbine wheels, couplings, shafts, bolts, at high temperature. Easy to forge.
G-192	C 0.60; Mn 8.50; Cr 22.00; N 0.35	
AF-183	C 0.30; Mn 18.00; Cr 12.00; Mo 3.00; V 0.75; N 0.20	Nickel-free austenitic grades developed by Allegheny Ludlum Steel Corp. for parts requiring high strength at elevated temperatures.
AF-71	C 0.30; Mn 18.00; Cr 12.00; Mo 3.00; V 0.75; N 0.30; B 0.20	
17-5 MnV (U. S. Steel)	C 0.10; Mn 15.00; Si 0.75*; Cr 17.00; Ni 5.00; Mo 2.00; V 0.75; N 0.35 min	Room and elevated temperature mechanical properties superior to those of commonly used 18-8 type austenitic stainless. For applications requiring bar and sheet material with high strength and corrosion resistance at room or elevated temperatures.
TBS-1000 (Timken)	C 0.70-0.90; Mn 0.40-0.60; Si 0.40-0.60; Cr 0.90-1.20; Mo 4.75-5.25	Antifriction bearings. Through hardening steel, retains high strength and hardness up to 1000° F.

TYPE: CHROMIUM-NICKEL-IRON ALLOYS

Alloy	Composition %	Properties and Applications
Unitemp 19-9DL Altemp 19-9 DL	C 0.30; Mn 1.10; Si 0.60; Cr 19.00; Ni 9.00; Mo 1.25; W 1.20; Cb 0.40; Ti 0.30; Fe 66.00	Jet engine, gas turbine, and turbocharger buckets, bolts, rotors, and sheet metal assemblies. Bolting and valve trim for refineries, boilers, and steam turbines.
Unitemp 19-9DX Altemp 19-9 9DX	C 0.30; Mn 1.00; Si 0.55; Cr 19.20; Ni 9.00; Mo 1.50; W 1.20; Ti 0.55; Fe 66.00	Cb-free version of above.
Unitemp 19-9WX Altemp 18-9 DX	C 0.11; Cr 20.50; Ni 8.50; Mo 0.50; W 1.50; Cb 1.30; Ti 0.20	Welding wire.
Incoloy Alloy	C 0.04; Mn 0.75; Si 0.35; Cr 20.50; Ni 32.50; Fe 45.50	Resistance to oxidation up to 1900° F. Similar to Inconel, but with improved resistance to attack by sulfur, green rot, molten cyanide salts; petrochemical equipment, heat treating fixtures.
Incoloy "T" Alloy	C 0.04; Mn 0.75; Si 0.35; Cr 20.50; Ni 32.50; Ti 1.00; Fe 44.50	Slightly better elevated temperature properties. Welded sheet metal components.
Croloy 15-15N	C 0.15*; Mn 2.00*; Si 0.75*; Cr 16.00; Ni 15.00; Mo 1.55; W 1.40; Cb 1.05; N 0.15*; Fe bal	Superheater tubing, steam piping.
17-14 Cu-Mo	C 0.12; Mn 0.75; Si 0.50; Cr 15.90; Ni 14.10; Mo 2.50; Cb 0.45; Ti 0.25; Cu 3.00; Fe bal	High strength austenitic stainless steel for service up to 1500° F. Aircraft gas turbines, boilers, etc.
Timken 16-25-6	C 0.08*; Mn 1.35; Si 0.70; Cr 16.00; Ni 25.00; Mo 6.00; N 0.15; Fe 50.00	Jet engine, gas turbine, and turbosupercharger wheels and buckets. Pickle chains. Bolting and sheet metal. Resists sea water.
Timken 16-15-6	C 0.07; Mn 7.50; Si 0.50; Cr 16.00; Ni 15.00; Mo 6.00; Fe 55.00; N 0.35	High temperature applications similar to above.
Discaloy 24	C 0.03; Mn 0.64; Si 0.92; Cr 13.10; Ni 25.50; Mo 2.83; Ti 1.83; Al 0.16; Fe bal	Turbine wheels, structural members, and fasteners in jet engine and gas turbine applications.
Croloy 16-8-2	C 0.10; Mn 1.50; Si 0.50; Cr 15.00; Ni 8.00; Mo 1.50; Fe bal	Welding wire for TP 316 and TP 347 steels.
A-286 A-286 AL	C 0.05; Mn 1.35; Si 0.95; Cr 15.00; Ni 26.00; Mo 1.75; Ti 2.00; Al 0.20; V 0.30; Fe bal	Jet engine and gas turbine wheels, bolts, discs. High strength, nonmagnetic. Available in all mill product forms.
W-545	C 0.05; Mn 1.50; Si 0.40; Cr 13.50; Ni 26.00; Mo 1.50; Ti 2.85; Al 0.20; B 0.08; Fe bal	High temperature, highly stressed parts in missiles, gas turbines, steam turbines; also low temperature use in retaining rings and wedges for electrical apparatus. Nonmagnetic with high yield strength.
EME	C 0.10; Mn 0.50; Si 0.70; Cr 19.00; Ni 12.00; W 3.20; Cb 1.20; N 0.15; Fe 63.00	Steam turbine bolting and valve stems.
NA-22H (Cast) (Blaw-Knox)	C 0.50; Mn 1.30; Si 1.00; Cr 27.00; Ni 48.00; W 6.00; Fe bal	Strength and oxidation resistance for use at 2200° F. Furnace muffles, fans, retorts, annealing and radiant tubes, baffle support bars, etc.
Crucible HNM	C 0.30; Mn 3.50; Cr 18.50; Ni 9.50; P 0.20; Fe bal	Aircraft sheet and bar applications. Compressor blades and sheets for turbine engines; nonmagnetic.
Crucible HTX	C 0.45; Mn 8.50; Cr 21.00; Ni 8.50; Mo 1.50; P 0.25; Fe bal	Turbine wheels, high temperature sheets for aircraft.
Cast HTX	C 0.45; Mn 8.00; Si 0.50; Cr 21.00; Ni 8.00; Mo 1.50; P 0.22; N 0.20; Fe bal	High strength and rupture properties up to 1600° F.
AMS 5700	C 0.45; Mn 0.70; Si 0.60; Cr 14.00; Ni 14.00; Mo 0.50; W 2.50	Good high temperature properties and resistance to corrosion in exhaust gases.
D-979 (Allegheny Ludlum)	C 0.01; Cr 14.00; Ni 45.00; Mo 4.00; W 4.00; Ti 4.00; Al 1.00; B 0.01; Fe bal	Highly stressed jet engine parts up to 1600° F. Has good workability. Allows production in all mill forms and formability in users' operations.
V-57	C 0.08*; Mn 0.25*; Si 0.55; Cr 14.75; Ni 25.50; Mo 1.25; Ti 3.00; Al 0.25; V 0.30; B 0.0075; Fe bal	High stress rupture and endurance limit; good transverse ductility. Wheels for turbojet engines, turbine cases, afterburner nozzles, aircraft fastenings.
22-4-9 (Armco)	C 0.45-0.60; Mn 7.00-10.00; Si 1.00*; Cr 20.00-23.00; Ni 3.00-5.00; N 0.30-0.50; Fe bal	Austenitic, nonmagnetic alloy with high strength and hardness up to 1600° F with good scaling resistance. Steam valves and gas turbine parts, nonmagnetic roller bearings and balls.
Gaman-H (Crucible)	C 0.65; Mn 12.00; Cr 25.00; N 0.40	Stretch and oxidation resistance for use at 2100° F.
17-7 PH (Armco)	C 0.09*; Mn 1.00*; Si 1.00*; Cr 16.00-18.00; Ni 6.50-7.75; Al 0.75-1.50; Fe bal	Hardenable by low temperature heat treatment to 180,000 psi min UTS and 150,000 psi min YS. Airframes, missiles, powerplants, etc. up to 900° F.
17-4 PH (Armco)	C 0.07*; Mn 1.00*; Si 1.00*; Cr 15.50-17.50; Ni 3.00-5.00; Cb 0.15-0.45; Cu 3.00-5.00; Fe bal	High strength, corrosion resistant, and no distortion by low temperature treatment. Valves, shafts, compressor blading, gears, bolting, and structural parts.
PH 15-7 Mo (Armco)	C 0.09*; Mn 1.00*; Si 1.00*; Cr 14.00-16.00; Ni 6.50-7.50; Mo 2.00-3.00; Al 0.75-1.50; Fe bal	Hardenable by low temperature treatment to 225,000 min UTS and 200,000 psi min YS. For aircraft and missile use up to 1000° F.
Unitemp 212 (Universal Cyclops)	C 0.08; Cr 16.00; Ni 25.00; Cb + Ta 0.50; Ti 4.00; Al 0.35; Zr 0.05; B 0.06; Fe bal	Jet engine and gas turbine buckets, bolts, discs, and other components which require particularly high strengths.
Unitemp 14-14W (Universal Cyclops)	C 0.45; Cr 14.00; Ni 14.00; W 2.40; Mo 0.35	Primarily used for exhaust valves and valve seat inserts; also for other engine components subjected to elevated temperatures.
AM-350 AM350AL	C 0.12; Mn 1.00; Si 0.50*; Cr 16.50; Ni 4.50; Mo 2.60; N 0.10; Fe bal	Sheet applications, compressor blades. Structural applications in airframes, missiles up to 900° F.
AM-355 AM355AL	C 0.12; Mn 1.00; Si 0.50*; Cr 15.50; Ni 4.50; Mo 2.75; N 0.10; Fe bal	Bar and billet version of AM-350 with similar properties in heavy sections.
Multimet Alloy (Wrought)	C 0.16*; Mn 1.50; Si 1.00*; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; N 0.20*; Cb + Ta 1.25*; Fe bal	Good oxidation and corrosion resistance up to 2000° F. Used where good ductility is a prime factor. Jet engine tail pipes, afterburners, and nozzle assemblies.
(Cast)	C 0.20*; Mn 1.50; Si 1.00*; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; N 0.20*; Cb + Ta 1.25*; Fe bal	
USS Stainless W	C 0.10; Mn 1.00; Ni 7.00; Cr 17.00; Ti 1.00	Precipitation hardening steel with low distortion on heat treatment. Can be age hardened to room temperature tensile of 200,000 psi.
S-590 S590AL	C 0.40; Mn 1.50; Si 0.70; Cr 20.00; Ni 20.00; Co 20.00; Mo 4.00; W 4.00; Fe 24.00; Cb 4.00	Wheels and buckets in stationary gas turbines.
Haynes Alloy #56	C 0.27; Mn 1.5; Si 1.0; Cr 21.0; Ni 13.0; Co 11.5; Mo 4.5; W 1.5; N 0.10; Cb&Ta 0.75; Fe bal	High temperature strength and ductility for 1200 to 2000° F applications. Good corrosion and oxidation resistance.

(Continued on Page S-10)

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
Refractaloy 26	C 0.03; Mn 0.80; Si 1.00; Cr 18.00; Ni 38.00; Co 20.00; Mo 3.20; Ti 2.60; Al 0.20; Fe bal	Superior strength at temperatures above 1250° F. Low magnetic response, good corrosion resistance. Buckets, bolts, coiled and flat springs, turbine discs.
Refractaloy 70	C 0.04; Mn 2.00; Si 0.30; Cr 20.00; Ni 21.00; Co 30.00; Mo 8.00; W 4.20; Fe bal	Gas turbine blades and nozzle vanes. Flat and coiled springs. High endurance limit at 1200° F.
Refractaloy 80	C 0.10; Mn 0.60; Si 0.70; Cr 20.00; Ni 20.00; Co 30.00; Mo 10.00; W 5.00; Fe bal	Used extensively for creep testing holders. High strength above 1300° F.
K42B	C 0.03; Mn 0.70; Si 0.70; Cr 18.00; Ni 42.00; Co 22.00; Ti 2.10; Al 0.20; Fe bal	High resistance to heat and corrosion. Low creep up to 1350° F. Gas and steam turbine blades, bolts.
TYPE: NICKEL-BASE ALLOYS		
Nicretung	C 0.10; Cr 12.00; Co 10.00; W 8.00; Ti 4.00; Al 4.00; B 0.05; Zr 0.05; Ni bal	High temperature cast alloy for applications in highly stressed parts at high temperatures in the 1500-2000° F range.
Inconel Alloy	C 0.04; Mn 0.35; Si 0.20; Cr 15.50; Ni 76.00; Fe 7.00	Resists oxidation up to 2200° F, carburizing and nitriding atmospheres, and corrosion. Manifolds, combustion liners, domes, transition liners.
Inconel "702" Alloy	C 0.04; Mn 0.10; Si 0.25; Cr 15.50; Ni 79.00; Al 3.00; Fe 0.50	Welded aero sheet metal components; exceptional resistance to oxidation over 1800° F.
Nimonic 75 Alloy	C 0.08-0.15; Mn 1.00*; Si 1.00*; Cr 18.00-21.00; Ti 0.20-0.60; Fe 5.00*; Ni bal	Similar to Inconel Alloy. Flame tubes, afterburners.
Inconel "M" Alloy	C 0.03; Mn 2.25; Si 0.10; Cr 16.00; Ni 71.50; Ti 3.00; Al 0.05; Fe 7.00	Age-hardenable Inconel Alloy. High strength and resistance to oxidation and leaded fuels. Valves for aviation piston type engines.
Inconel "X" Alloy	C 0.04; Mn 0.70; Si 0.30; Cr 15.00; Ni 73.00; Cb 0.90; Ti 2.50; Al 0.90; Fe 7.00	Age-hardenable Inconel Alloy. Oxidation resistance, high strength up to 1500° F. Blades, rotors, bolting, welded sheet metal components.
Inconel "X," "550" Alloy	C 0.04; Mn 0.70; Si 0.40; Cr 15.00; Ni 73.00; Cb 0.90; Ti 2.40; Al 0.90; Fe 7.00	Inconel "X" with increased hardener; turbine blades.
Nimonic 80A Alloy	C 0.10*; Mn 0.10*; Si 1.00*; Cr 18.00-21.00; Co 2.00*; Ti 1.80-2.70; Al 0.50-1.80; Fe 5.00*; Ni bal	Rotor turbine blades—up to 1400° F; stator blades.
Nimonic 90 Alloy	C 0.10*; Mn 1.00*; Si 1.50*; Cr 18.00-21.00; Co 15.00-21.00; Ti 1.80-3.00; Al 0.80-2.00; Fe 5.00*; Ni bal	Rotor turbine blades—up to 1550° F.
Inconel "700" Alloy	C 0.13; Mn 0.03; Si 0.25; Cr 15.00; Ni 46.00; Co 29.00; Mo 3.00; Ti 2.20; Al 3.20; Fe 0.80	Rotor turbine blades—up to 1650° F.
Hastelloy Alloy B (Wrought)	C 0.05*; Mn 1.00*; Si 1.00*; Cr 1.00*; Co 2.50*; Mo 28.00; Fe 5.50; V 0.40*; Ni bal	Outstanding resistance to hot hydrochloric acid, wet hydrogen chloride gas and other reducing agents. Oxidation rate in air is low enough for use up to 1400° F.
(Cast)	C 0.12*; Mn 1.00*; Si 1.00*; Cr 1.00*; Co 2.50*; Mo 28.00; Fe 5.50; V 0.60*; Ni bal	
Hastelloy Alloy C (Wrought)	C 0.08*; Mn 1.00*; Si 1.00*; Cr 15.50; Co 2.50*; Mo 16.00; W 3.75; Fe 5.50; V 0.35*; Ni bal	Good all around high temperature properties, particularly for parts highly stressed or subjected to repeated thermal shock at 1600-1800° F. Withstands strong oxidizing conditions, sea water and acetic, formic, phosphoric, sulfurous, and sulfuric acids.
(Cast)	C 0.12*; Mn 1.00*; Si 1.00*; Cr 16.50; Co 2.50*; Mo 17.00; W 4.50; Fe 5.50; V 0.40*; Ni bal	
Hastelloy Alloy R-235 (Wrought)	C 0.16*; Mn 1.00*; Si 1.00*; Cr 15.00; Co 2.50*; Mo 5.00; Ti 2.50; Al 2.00; Fe 10.00; Ni bal	Vacuum melted, precipitation hardening alloy with excellent strength up to 1750° F.
GMR-235 (Cast)	C 0.20*; Mn 0.25*; Si 0.60*; Cr 15.50; Mo 5.25; Ti 2.00; Al 3.00; Fe 10.00; B 0.07; Ni bal	Has excellent stress rupture properties at high stresses up to 1700° F. Vacuum melted.
GMR-235D (Cast)	C 0.15; Mn 0.10*; Si 0.30*; Cr 15.50; Mo 5.25; Ti 2.50; Al 3.60; Fe 4.25; B 0.07; Ni bal	Investment cast. Vacuum melted. Average rupture life 160 hours. 1600° F, 28,000 psi. Applications same as GMR-235.
Incoloy "901" Alloy Altemp 1251	C 0.05; Mn 0.50; Si 0.35; Cr 13.00; Ni 40.00; Mo 6.00; Ti 2.50; Al 0.20; B 0.01-0.05; Fe bal	Matches mechanical properties of Inconel "X" at temperatures to 1350° F; turbine discs and parts where high tensile, creep, and rupture strengths are needed in the 1000-1400° F range.
Inconel "713C" Alloy (Cast); Haynes 713C Alloy	C 0.12; Mn 0.15; Si 0.40; Cr 13.00; Mo 4.50; Cb 2.25; Ti 0.60; Al 6.00; Fe 1.00; Ni bal	Has high rupture strength to 1700° F and above, exceptional resistance to thermal fatigue, good castability; turbine blades in advanced engines.
Inconel "717C" Alloy (Cast)	C 0.12; Cr 11.00; Co 8.00; Mo 4.50; Cb 2.00; Ti 1.00; Al 7.50; Ni bal	Turbine blades for 1800° F operation.
Inconel "718" Alloy	C 0.05; Mn 0.30; Si 0.40; Cr 18.00; Ni 53.00; Mo 3.00; Ti 0.80; Al 0.40; Cb + Ta 5.00	Age hardenable alloy with exceptionally high yield strength up to 1400° F. Weldable, corrosion resistant.
Hastelloy Alloy X (Wrought) Unitemp HX	C 0.10; Mn 1.00*; Si 1.00*; Cr 22.00; Co 1.50; Mo 9.00; W 0.60; Fe 18.50; Ni bal	Good scale resistance to 2200° F. Excellent for cast and fabricated heat treating equipment.
(Cast)	C 0.20*; Mn 1.00*; Si 1.00*; Cr 22.00; Co 1.50; Mo 9.00; W 0.60; Fe 18.50; Ni bal	
Waspaloy	C 0.05; Cr 19.50; Co 13.50; Mo 4.00; Ti 3.00; Al 1.25; Zr 0.06; B 0.005; Fe 2.00*; Ni bal	Gas turbine buckets. Largely vacuum melted.
Udimet 500 Hastelloy 500	C 0.15*; Mn 0.75; Si 0.75; Cr 20.00; Co 13.00; Mo 4.00; Ti 3.00; Al 2.75; Fe 4.00*; Ni bal	Gas turbine components. High strength at elevated temperatures. Vacuum melted.
Unitemp 1753	C 0.24; Cr 16.25; W 8.40; Mo 1.60; Co 7.20; Ti 3.15; Al 1.90; Zr 0.06; B 0.008; Fe 9.50; Ni bal	Gas turbine components where especially high strength at elevated temperatures is required.
Thetalloy (Cast)	Mn 2.50; Cr 25.00; Co 12.50; Mo 3.00; W 7.00; Ni bal	Gas turbine diaphragms.

Alloy	Composition %	Properties and Applications
Astroloy	C 0.05; Mn 0.70*; S 0.015*; Si, 0.10*; Fe 0.20*; Cr 15.0; Mo; 5.0; Co 15.0; Ti 3.50; Al 4.30; B 0.03; Ni bal	Has 150,000 psi min tensile at 1400° F.
Rene 41 Altemp R-41	C 0.09; Cr 19.00; Co 11.00; Mo 10.00; Ti 3.10; Al 1.50; B 0.005; Ni bal	High strength to 1800° F. Readily forged, formed and welded. Jet engine parts.
J-1500	C 0.15; Cr 20.00; Co 10.00; Mo 10.00; Ti 3.00; Al 1.00; Ni bal	Turbine buckets and components. High strength to 1600° F.
M-252 (GE)	C 0.10; Mn 1.00; Si 0.70; Cr 19.00; Ni 54.00; Co 10.00; Mo 10.00; Ti 2.50; Al 0.75; B 0.005; Fe 2.00	Gas turbine buckets, torque rings. Vacuum melted.
Illium G	C 0.25; Mn 0.35; Si 0.90; Cr 22.00; N, 58.50; Mo 6.00; Fe 6.00; Cu 6.00	High temperature and corrosion resistant applications.
Illium R	C 0.07; Mn 0.40; Si 0.11; Cr 22.00; Ni 64.00; Mo 5.00; Fe 6.00; Cu 2.50	High temperature and corrosion resistant applications.

TYPE: COBALT-BASE ALLOYS

Haynes Stellite Alloy No. 21 (Cast)	C 0.30*; Mn 1.00*; Si 1.00*; Cr 27.00; Ni 2.75; Mo 5.50; Fe 2.00*; Co bal	Resists oxidizing and reducing atmospheres up to 2100° F. Good high temperature strength, thermal shock resistant.
Haynes Stellite Alloy No. 30 (Cast)	C 0.50*; Mn 1.00*; Si 1.00*; Cr 26.00; Ni 15.00; Mo 6.00; Fe 2.00*; Co bal	Excellent creep properties at 1600° F. Modulus of elasticity does not drop off rapidly and endurance properties are good.
Haynes Stellite Alloy No. 31 (Cast) (X-40)	C 0.55*; Mn 1.00*; Si 1.00*; Cr 25.50; Ni 10.50; W 7.50; Fe 2.00*; Co bal	Good endurance and creep properties. Stress-rupture strength 27,000 psi at 1500° F for 100 hours.
Haynes Alloy No. 36 (Cast)	C 0.45*; Mn 1.50*; Si 1.00*; Cr 18.50; Ni 10.00; W 15.00; Fe 2.00*; B 0.05*; Co bal	Cast modification of Alloy No. 25. Excellent creep and rupture properties. Good ductility.
Haynes Alloy No. 25 (Wrought)	C 0.15*; Mn 1.50; Si 1.00*; Cr 20.00; Ni 10.00; W 15.00; Fe 3.00*; Co bal	Exceptional high temperature strength. Good forming and welding characteristics. Used for nozzle partitions, afterburner assemblies.
WF-11 (Crucible) Unitemp L-605 Altemp L-605	C 0.15; Mn 1.50; Si 0.50; Cr 20.00; Ni 10.00; W 15.00; Fe 3.00*; Co bal	Afterburner sheets, turbine rings, nozzle vanes in turbine engines—6000 psi for 100 hours at 1800° F.
J-1570	C 0.20; Cr 20.00; Ni 28.00; W 6.00; Ti 4.00; Co bal	Gas turbine buckets and high temperature sheet metal parts. Vacuum melted. Can be forged and welded.
S-816 (Allegheny Ludlum)	C 0.38; Mn 1.50; Si 0.70; Cr 20.00; Ni 20.00; Co 43.00; Mo 4.00; W 4.00; Cb 4.00; Fe 3.00	Jet engine buckets. High temperature springs. Steam turbine bolting and buckets.
V-36 (Allegheny Ludlum)	C 0.31; Mn 0.90; Si 0.50; Cr 25.00; Ni 20.00; Co 42.00; Mo 4.00; W 2.00; Cb 2.20; Fe 3.00	Sheet uses over 1800° F requiring high tensile, rupture, and creep strengths.
Nivco	C 0.02; Mn 0.35; Si 0.15; Ni 22.50; Co 73.50; Ti 1.80; Al 0.22; Fe 0.30; P 0.005; S 0.009; Zr 1.10	High damping material with good high temperature strength for applications to 1200° F. Applications include low noise gearing, Precipitron wires, nonvibratory tool supports, and compressor blades.
Haynes Alloy No. 151 (Cast)	C 0.48; Mn 1.00*; Si 1.00*; Cr 20.00; W 12.75; Ni + Fe 3.00*; B 0.05; Co bal	For integrally cast turbine wheels operating at 1200-1600° F. For stationary turbine vanes operating at 1700-1800° F.

TYPE: MOLYBDENUM-BASE ALLOYS

Climelt Molybdenum (Climax Molybdenum) Refractomet Pure Molybdenum (Universal-Cyclops)	Electric and electronic parts; rocket nozzles; furnace parts. Boring bars, grinding quills, wear resistant room temperature uses.
Pure Molybdenum (General Electric)	Missile and rocket parts, electrical contacts, semiconductor devices, lamps, and electronic tubes.
Refractomet Molybdenum 0.5% Ti Alloy Climelt Molybdenum 0.5% Ti Alloy Ormet Molybdenum 0.5% Ti Alloy	Piercer points; experimental gas turbine buckets and guide vanes. Useful strength at temperatures above 1600° F greater than superalloys. Must be protected against oxidation at elevated temperatures.
Climelt Molybdenum 30% W	Ultrahigh temperature service material. Has better corrosion resistance than unalloyed molybdenum in some mediums. Nozzles and other missile parts.

TYPE: TUNGSTEN-BASE ALLOYS

Pure Tungsten	Tensile strength of 50,000 to 900,000 psi with up to 4% elongation depending on form and work history. Uses are same as for molybdenum.
Tungsten-Molybdenum Alloy (50-50)	Tensile strength of 60,000 to 300,000 psi depending on form and work history, and 2% to 5% ductility depending on treatment. Used for rocket and missile parts.
Tungsten-Molybdenum (60W-40 Mo)	Jet vanes.
Tungsten-Molybdenum (85W-15 Mo)	Rocket exhaust nozzles. Ingots or cylindrical castings.

*Indicates maximum.
Note: This chart does not include the AISI grades of stainless and heat resistant steels, many of which are specified for high temperature applications.

STAINLESS AND HEAT-RESISTANT STEELS

AISI No.	C	Mn Max	Si Max	Cr	Ni	P Max	S Max	Properties and Applications
201	0.15 max Other: N 0.25 max	5.5–7.50	1.00	16–18	3.5–5.5	0.060	0.030	Low-nickel alternate for 301; somewhat higher strength than 301. General applications similar to 301.
202	0.15 max Other: N 0.25 max	7.5–10.00	1.00	17–19	4–6	0.060	0.030	Low-nickel alternate for 302; somewhat higher strength than 302. General applications similar to 302.
301	0.15 max	2.00	1.00	16–18	6–8	0.045	0.030	Rapid work hardening. Railroad cars, trailer bodies, aircraft structurals.
302	0.15 max	2.00	1.00	17–19	8–10	0.045	0.030	General purpose, chromium nickel type. Trim, food handling equipment, jewelry, aircraft cowling, antennas, springs, architectural, cookware.

(Continued on Page S-12)

STAINLESS AND HEAT RESISTANT STEELS (continued)

AISI No.	C	Mn Max	Si Max	Cr	Ni	P Max	S Max	Properties and Applications
302B	0.15 max	2.00	2.0–3.0	17–19	8–10	0.045	0.030	Higher scaling resistance at elevated temperatures than 302. Furnace parts, still liners, heating elements.
303	0.15 max Other: Mo 0.60 max‡	2.00	1.00	17–19	8–10	0.20	0.15 min	Free machining; lower galling and seizing tendency than 302. Screw machine products, shafts, valves.
303Se	0.15 max Other: Se 0.15 min	2.00	1.00	17–19	8–10	0.20	0.06	Better transverse properties, lower machinability, better finish than 303; improved workability.
304†	0.08 max	2.00	1.00	18–20	8–12	0.045	0.030	General purpose alloy for welding. Chemical and food processing equipment, recording wire.
304L	0.03 max	2.00	1.00	18–20	8–12	0.045	0.030	Weldments for corrosive conditions where intergranular carbide precipitation must be avoided. Atomic energy applications.
305	0.12 max	2.00	1.00	17–19	10–13	0.045	0.030	Low work-hardening rate. Maximum plasticity for forming, spinning, cold heading.
308	0.08 max	2.00	1.00	19–21	10–12	0.045	0.030	Welding rods and electrodes.
309	0.20 max	2.00	1.00	22–24	12–15	0.045	0.030	High scale resistance, good strength at high temperatures. Aircraft heaters, heat treating equipment, annealing covers, furnace parts.
309S	0.08 max	2.00	1.00	22–24	12–15	0.045	0.030	Weldments with high scale resistance.
310	0.25 max	2.00	1.50	24–26	19–22	0.045	0.030	Like 309 but even higher heat resistance. Excellent for general use. Heat exchangers, furnace parts, combustion chambers, welding rods.
310S	0.08 max	2.00	1.50	24–26	19–22	0.045	0.030	Like 309S but has even higher heat resistance.
314	0.25 max	2.00	1.5–3.0	23–26	19–22	0.045	0.030	Highest heat resistance. Uses similar to 310. Resistant to carburizing. Heat treating fixtures.
316†	0.08 max Other: Mo 2.00–3.00	2.00	1.00	16–18	10–14	0.045	0.030	Higher resistance to corrosives affecting other stainless steels. High creep resistance. High temperature parts, chemical and pulp handling equipment, photographic and food equipment.
316L	0.03 max Other: Mo 2.00–3.00	2.00	1.00	16–18	10–14	0.045	0.030	Version of 316 for weldments where intergranular carbide precipitation must be avoided. Permits stress relief at 1550–1650° F.
317	0.08 max Other: Mo 3.00–4.00	2.00	1.00	18–20	11–15	0.045	0.030	Higher in corrosion resistance than 316.
D319	0.07 max	2.00	1.00	17.5–19.5	11–15	0.045	0.030	Modification of 316. Slightly superior to 316 for chemical service.
321†	0.08 max Other: Ti 5xC min	2.00	1.00	17–19	9–12	0.045	0.030	For weldments subject to severely corrosive conditions and service in 800–1650° F range. Aircraft exhaust manifolds, boiler shells, expansion joints, process equipment.
347†	0.08 max Other: Cb-Ta 10xC min	2.00	1.00	17–19	9–13	0.045	0.030	For uses similar to 321. More widely used for welded process equipment.
348†	0.08 max Other: Cb-Ta 10xC min, Ta 0.10 max; Co 0.20 max	2.00	1.00	17–19	9–13	0.045	0.030	Equivalent to 347. For atomic energy applications due to low retentivity.
403*	0.15 max	1.00	0.50	11.5–13	.....	0.040	0.030	Steam turbine blades, jet engine compressor blades, highly stressed parts.
405	0.08 max Other: Al 0.10–0.30	1.00	1.00	11.5–14.5	.....	0.040	0.030	Nonhardenable. For welded assemblies where air-hardening of 410 or 403 is objectionable.
410*	0.15 max	1.00	1.00	11.5–13.5	.....	0.040	0.030	General purpose corrosion and heat resistance. Hardenable by heat treatment. Coal screens, low priced cutlery, machine parts, valve trim.
414*	0.15 max	1.00	1.00	11.5–13.5	1.25–2.50	0.040	0.030	High-strength version of 410. Rules and straight edges, mild springs, scraper knives.
416*	0.15 max Other: Mo 0.60 max‡	1.25	1.00	12–14	.....	0.06	0.15 min	Free machining. Bolts, nuts, screws, carburetor parts, fishing reels, golf club heads, instrument parts, screw machine parts, valve trim.
416Se*	0.15 max Other: Se 0.15 min	1.25	1.00	12–14	.....	0.06	0.06	Higher transverse properties, better finish, lower machinability than 416; improved workability.
420*	Over 0.15	1.00	1.00	12–14	.....	0.040	0.030	High hardness from heat treatment. General purpose cutlery grade. Surgical instruments.
430	0.12 max	1.00	1.00	14–18	.....	0.040	0.030	General purpose, nonhardenable chromium type. Decorative trim, nitric acid tanks, annealing baskets, auto trim, sinks.
430F	0.12 max Other: Mo 0.60 max‡	1.25	1.00	14–18	.....	0.06	0.15 min	Free-machining bars. Screw machine parts, screws and other fasteners.
430FSe	0.12 max Other: Se 0.15 min	1.25	1.00	14–18	.....	0.06	0.06	Free machining, retaining forgeability. Fine finish quality. Similar to 430F.
431*	0.20 max	1.00	1.00	15–17	1.25–2.50	0.040	0.030	Special purpose hardenable type. Aircraft fittings, bolts, paper machinery, windshield wiper arms, beater bars, springs.
440A*	0.60–0.75 Other: Mo 0.75 max	1.00	1.00	16–18	.....	0.040	0.030	High strength and corrosion resistance. Hardenable by heat treatment. Toughest high chrome cutlery grade, bearings, seaming rolls, surgical tools.
440B*	0.75–0.95 Other: Mo 0.75 max	1.00	1.00	16–18	.....	0.040	0.030	Cutlery grade. Uses similar to 440A.
440C*	0.95–1.20 Other: Mo 0.75 max	1.00	1.00	16–18	.....	0.040	0.030	Ball bearing grade. Also bushings, valve parts, cutlery.
446	0.20 max Other: N 0.25 max	1.50	1.00	23–27	.....	0.040	0.030	Resistance to high-temperature scaling, hot sulfur-bearing gases and oxidizing acids.
501*	Over 0.10 Other: Mo 0.40–0.65	1.00	1.00	4–6	.....	0.040	0.030	Moderate resistance to scaling but limited corrosion resistance. Oil industry equipment—stills, heat exchangers, hot lines.
502*	0.10 max Other: Mo 0.40–0.65	1.00	1.00	4–6	.....	0.040	0.030	Uses similar to 501.

‡At producer's option; reported only when intentionally added.
*Respond to heat treatment to develop a wide range of mechanical properties.
†ASTM grades with prefix "TP," suffix "H" (for heat treated) used at temperatures over 1000° F. ASTM specification A 213-60T.

CAST HIGH ALLOYS

Corrosion & Heat Resistant

ACI Designation	Equiv. (Wrought)	Nominal Composition %	Outstanding Properties and Typical Uses
CA-15	410	C 0.15 max; Mn 1.00 max; Si 1.50 max; Cr 11.5-14.0; Ni 1.0 max; Mo 0.5 max*; Fe bal	Hardenability, 144 to 400 BHN. Good atmospheric corrosion resistance. Pump casings, bushings and liners, impellers, shafts, turbine blades, stuffing boxes, valve bodies and trim, fittings, furnace burner tips, and pilot cones.
CA-40	420	C 0.20-0.40; Mn 1.00 max; Si 1.50 max; Cr 11.5-14.0; Ni 1.0 max; Mo 0.5 max*; Fe bal	Hardenability, up to 500 BHN. Corrosion resistance same as CA-15. Choppers, cutting blades, cylinder liners, pump parts, steam turbine parts, molds, dies.
CB-30	431	C 0.30 max; Mn 1.00 max; Si 1.00 max; Cr 18-22; Ni 2.0; Fe bal	Resists nitric acid, alkali, and many organic chemicals. Good machinability. Furnace brackets and hangers, pump parts, rabble arms, tube supports, valve bodies and parts.
CC-50	446	C 0.50 max; Mn 1.00 max; Si 1.00 max; Cr 26-30; Ni 4.0 max; Fe bal	Magnetic, good machinability; resists dilute sulfuric acid, mixed nitric and sulfuric acids, and oxidizing acids. Bushings, cylinder liners, pump casings and impellers, valve bodies and seats.
CD-4MCu	...	C 0.040 max; Mn 1.00 max; Si 1.00 max; Cr 25-27; Ni 4.75-6.00; Mo 1.75-2.25; Cu 2.75-3.25; Fe bal	High strength, precipitation hardening alloy with corrosion resistance equal to CF-8. Hardenability, 290 to 320 Brinell. Valve trim, pumps, fittings, high pressure parts, gears.
CE-30	312	C 0.30 max; Mn 1.50 max; Si 2.00 max; Cr 26-30; Ni 8-11; Fe bal	Better strength and ductility than CC-50; useful where castings cannot be heat treated. Resists sulfurous acid and sulfites. Process industry equipment such as digester fittings, fractionating towers, pipings, pump bodies and casings, valve bodies and parts.
CF-3	304L	C 0.03 max; Mn 1.50 max; Si 2.00 max; Cr 17-21; Ni 8-12; Fe bal	Lower carbon modification of CF-8. Useful where castings cannot be heat treated after welding.
CF-8	304	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 8-11; Fe bal	High impact strength at low temperatures. Resists strong oxidants such as boiling nitric acid. Autoclaves, blast furnace bushings, filter press plates, hardware, headers and heating coils, pump parts, spray nozzles, valve parts.
CF-20	302	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 8-11; Fe bal	High ductility and impact strength. Satisfactory in many oxidizing environments. Cylinder liners, pumps, return bends, rolls, circuit breaker parts, valve parts.
CF-3M	316L	C 0.03 max; Mn 1.50 max; Si 1.50 max; Cr 17-21; Ni 9-13; Mo 2.0-3.0; Fe bal	Lower carbon modification of CF-8M. Useful where castings cannot be heat treated after welding.
CF-8M	316	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Mo 2.0-3.0; Fe bal	Used up to 1000° F—ductile and strong. Resists reducing solutions and pitting corrosion in sea water. Agitators, evaporator parts, jet engine components, spray nozzles, high pressure steam valves.
CF-12M	316	C 0.12 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Mo 2.0-3.0; Fe bal	Preferred over CF-8M for operating temperatures above 1200° F; corrosion resistance not quite as good as CF-8M. Agitators, evaporator parts, jet engine components, spray nozzles, high pressure steam valves.
CF-8C	347	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Cb 8 x C min, 1.0 max or Cb + Ta 10 x C min, 1.35 max; Fe bal	Suitable for field welding. Corrosion resistance similar to CF-8. Aircraft shroud assemblies, autoclaves, chemical tubing, fittings, jet engine parts, marine fittings.
CF-16F	303	C 0.16 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Se 0.20-0.35; Mo 1.50 max; P 0.17 max; Fe bal	Improved machinability, good welding characteristics. Corrosion resistance inferior to CF-20, but adequate for many purposes. Bearings, bushings, fittings, pump and machinery parts.
CG-8M	317	C 0.08 max; Mn 1.50 max; Si 1.50 max; Cr 18-21; Ni 9-13; Mo 3.0-4.0; Fe bal	Properties similar to CF-8M, but preferred in reducing environments. Especially useful for applications in the pulp and paper industry.
CH-20	309	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 22-26; Ni 12-15; Fe bal	More ductile than CE-30 but not as strong; stronger than CF-8 but not as ductile. Resists hot dilute sulfuric acid. Digester fittings, roasting equipment, valves.
CK-20	310	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 23-27; Ni 19-22; Fe bal	Withstands elevated temperatures, resists dilute sulfuric acid. Digesters filter press parts, fittings, jet engine parts, pumps, valves.
CN-7M	...	C 0.07 max; Mn 1.50 max; Si 1.50 max; Cr 19-22; Ni 27.5-30.5; Mo 1.75-2.50; Cu 3.00 min; Fe bal	Good machining and fair welding properties, nonmagnetic. Resists: Sulfuric acid, reducing chemicals, dilute hydrochloric acid, hot chlorides and nitric acid. Filter parts, heat exchanger parts, pickling rolls, hooks, and racks.
HA	...	C 0.20 max; Mn 0.35-0.65; Si 1.00 max; Mo 0.90-1.20; Cr 8-10; Fe bal	Maximum use temperature: 1300° F. Fan blades for hot gases, trunnions for glass rolls.
HC	446	C 0.50 max; Mn 1.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 4 max; Fe bal	Maximum use temperature: 1200° F with moderately heavy loading; 1900° F with light loading. Used in sulfur atmosphere when heavy loading is not involved; in ore roasting furnaces for parts such as rabble arms and blades.
HD	327	C 0.50 max; Mn 1.50 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 4-7; Fe bal	Properties and uses same as Type HC with greater strength at elevated temperatures. Useful in sulfur atmospheres. Ore roasting furnace parts, salt pots, grate bars.
HE	312	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 8-11; Fe bal	Maximum use temperature: 2000° F. Good corrosion resistance and ductility; moderate strength at elevated temperatures. Stands sulfur atmospheres.
HF	302B	C 0.20-0.40; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 19-23; Ni 9-12; Fe bal	Maximum use temperature: 1600° F. Good corrosion resistance in the range 1200-1600° F. Oil refineries for tube supports and beams; cement mill parts, ore roasting furnace parts, heat treating furnaces.
HH	309	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; N 0.2 max; Cr 24-28; Ni 11-14; Fe bal	Maximum use temperature: 2000° F. High strength and oxidation resistance at elevated temperatures. Depending on composition, the alloy can be partially ferritic or fully austenitic. Tube supports and beams in oil refineries, ore roasting furnace parts, and heat treating parts.
HI	...	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 14-18; Fe bal	Maximum use temperature: 2150° F. Cast retorts for magnesium production.
HK	310	C 0.20-0.60; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 24-28; Ni 18-22; Fe bal	Maximum use temperature: 2100° F. Resists hot gas corrosion better than Type HH. Not recommended where severe thermal shock is involved. Used where high creep strength is needed; jet engines, gas turbines, furnace parts.
HL	...	C 0.20-0.60; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 28-32; Ni 18-22; Fe bal	Maximum use temperature: 1800° F. Good corrosion resistance in sulfur atmospheres. Gas dissociation equipment, fixtures.
HN	...	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 19-23; Ni 23-27; Fe bal	Good high temperature strength and corrosion resistance in chemically reactive media. Brazing fixtures for use up to 2060° F.
HT	330	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 13-17; Ni 33-37; Fe bal	Maximum use temperature: 2100° F in oxidizing and 2000° F in reducing atmospheres. Excellent service life where subject to rapid heating and cooling. Heat treating furnace parts such as rails, rolls, discs, chains, boxes, pots, and fixtures subject to cyclic heating. Also used for glass rolls, enameling racks.
HU	...	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 17-21; Ni 37-41; Fe bal	Strength and corrosion resistance at high temperatures; similar to HT. Used where improved resistance to hot gas corrosion is required.

(Continued on Page S-14)

CAST HIGH ALLOYS (continued)

ACI Designation	Equiv. (Wrought)	Nominal Composition %	Outstanding Properties and Typical Uses
HW	...	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 10-14; Ni 58-62; Fe bal	Maximum use temperature: 2050° F in oxidizing, 1900° F in reducing atmospheres. Excellent for severe service at high temperatures involving cyclic heating or thermal shock. Hearths, muffles, retorts, trays, boxes, burner parts, enameling fixtures, quenching fixtures, molten lead containers.
HX	...	Cr 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 15-19; Ni 64-68; Fe bal	Maximum use temperatures same as HW, but better in resistance to reducing gases containing sulfur at 1800° F. Used in contact with tempering and cyaniding salts. Same applications as HW, improved resistance to hot gas corrosion.

NOTES:

*Molybdenum is not intentionally added to these compositions.

1. Sulfur does not exceed 0.04 per cent in any composition. Except for Type CF-16F, phosphorus does not exceed 0.04 per cent in any composition.
2. Most of the standard grades listed are covered for general applications by American Society for Testing Materials specifications A 296-55 and A 297-55. ASTM specifications A 217-55, A351-58T, A362-52T, B 190-50 and B 207-50 also apply to some of the grades.
3. Cast alloy chemical composition ranges *are not the same* as the wrought alloys. Buyers should use cast alloy designations for proper identification of castings.

FERROUS CASTINGS

DUCTILE (Nodular or Spheroidal Graphite) IRON

Specification	Class or Grade	Tensile Min (psi)	Yield Min (psi)	Elong. in 2 in. (min %)	Heat Treatment	Properties and Typical Applications
ASTM A339-55	80-60-03	80,000	60,000	3	.....	High strength in as-cast condition. Heavy duty machinery, gears, dies, rolls.
	60-45-10	60,000	45,000	10	Usually annealed	Toughness and machinability. Pressure castings, valves, pump bodies, compressor heads, shock resisting parts.
MIL-I-17166A (ships)	60-40-15	60,000	40,000	15	Ferritized by annealing to 190 max BHN	Navy shipboard and other uses requiring shock resistance. Motor frames, ends, engine blocks, heads, compressors, valves, clamps.
ASTM A396-58	120-90-02	120,000	90,000	2	Heat treated	For high strength applications (obtained by heat treatment), pinions, gears, cams, guides, track rollers.
	100-70-03	100,000	70,000	3		
MIL-I-11466 (ordnance)	Class 1	120,000	90,000	2	Usually quenched and tempered	Military equipment.
	Class 2	100,000	75,000	4		
	Class 3	85,000	60,000	6		
	Class 4	80,000	60,000	3	As-cast	(Unless otherwise specified, one metallographic test shall be made for each lot.)
	Class 5	60,000	45,000	10	Ferritized by annealing	
	Class 6	60,000	40,000	18		

Source: Gray Iron Founders' Society Inc.

MALLEABLE IRON

ASTM Spec. No.	Grade No.	Tensile* Min (psi)	Yield* Min (psi)	Elong. in 2 in. (min %)	Properties and Typical Applications
		STANDARD			
A-47-52	32510	50,000	32,500	10	Tough, impact and fatigue resistant, easily machined, uniform structure. Castable in ⅛-in. minimum sections. Automobile, truck differential cases, carriers, steering gear housings, brackets, railroad car and track parts, agricultural implement parts, conveyor and electrical fittings.
	35018	53,000	35,000	18	
		PEARLITIC			
A-220-55T	45010	65,000	45,000	10	High strength, hardness, resistance to abrasion, good machinability. Has castability and excellent surface finish of standard malleable. Hardenable to 50-60 Rc. Automotive valve rocker arms, automatic transmission parts, agricultural implement gears, sprockets, crankshafts, weapon parts, diesel electric power switch segment gears, armature and frame heads, gear cases, shifter forks.
	45007	65,000	45,000	7	
	48004	70,000	48,000	4	
	50007	75,000	50,000	7	
	53004	80,000	53,000	4	
	60003	80,000	60,000	3	
	80002	100,000	80,000	2	
SAE	43010	60,000	43,000	10	
	48005	70,000	48,000	5	
	53004	80,000	53,000	4	
	60003	80,000	60,000	3	
	70002	90,000	70,000	2	

Source: Malleable Founders' Society.

*Higher tensile and yield strengths may be obtained from any of the pearlitic malleable grades by a conventional quench-and-temper treatment.

CAST STEEL—Carbon Structural Grades

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Carbon (max %)	Manganese (max %)	Properties and Typical Applications
A-27-58	N-1	.....	.....	..	0.25	0.75	
	N-2	.....	.....	..	0.35	0.60	Low electrical resistivity, excellent weldability. Can be carburized and case hardened. Electrical equipment gears, drums, railroad and furnace equipment.
	N-3	.....	.....	..	...	1.00	
	U-60-30	60,000	30,000	22	0.25	0.75	
	60-30	60,000	30,000	24	0.30	0.60	
	65-30	65,000	30,000	20	...	...	Excellent weldability, medium strength, good durability and machinability. Railroad, power shovel, rolling mill equipment, presses, gears, sprockets, machine frames, miscellaneous medium strength castings.
	65-35	65,000	35,000	24	0.30	0.70	
	70-36	70,000	36,000	22	0.35	0.70	
	70-40	70,000	40,000	22	0.25	1.20	

CAST STEEL—Carbon Structural Grades (continued)

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Carbon (max %)	Manganese (max %)	Properties and Typical Applications
SAE	0022	.....	.....	..	0.22	0.90	High strength, toughness, good fatigue, wear resistance, high rigidity. Gears, rolls, blanking and forming dies, pinions, sprockets, machine tools, impellers, liners, castings requiring rigidity and hardness.
Automotive	0030	65,000	35,000	24	0.30	0.70	
Steel Castings	0050	85,000	45,000	16	0.50	0.90	
	0050	100,000	70,000	10	0.50	0.90	
	080	80,000	40,000	18	...	...	

CAST STEEL—Low Alloy Engineering Grades

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Properties and Typical Applications
A-148-58	80-40	80,000	40,000	18	Excellent weldability, medium strength, high toughness, good machinability, shock and abrasion resistant. Pneumatic tools, railroad equipment, pressure parts, automotive parts, track wheels, tractor treads, gears, sprockets.
SAE 090	80-50	80,000	50,000	22	
	90-60	90,000	60,000	20	Offers a variety of strengths and hardenabilities depending on alloy content. Good fatigue properties. Normalized and tempered: Oil well tools, sheaves, sprockets, locomotive parts; gears, cams, earth moving equipment, highly stressed parts. Quenched and tempered: Gears, cams, rollers, bucket teeth, small crusher jaws, conveyor chain links, dredge pumps, impellers, valve liners, oil field tongs. Good impact properties.
SAE 0105	105-85	105,000	85,000	17	High resistance to impact, excellent strength and toughness. Normalized and tempered: Excellent air hardening properties. Abrasion resistant applications, dredge pumps, gears, dies, rolling mill equipment, shock valves, flanges, turbine casings, hydroelectric equipment. Quenched and tempered: Good low temperature impact toughness, excellent abrasion resistance, deep hardening.
SAE 0120	120-95	120,000	95,000	14	
SAE 0150	150-125	150,000	125,000	9	Deep hardening, high strength, and wear resistance.
SAE 0175	175-145	175,000	145,000	6	

CAST STEEL—High and Low Temperature Service

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Bend and Impact Properties	Properties and Typical Applications
A-216-59T	WCA	60,000	30,000	24	90 degree bend*	A-216-59T carbon steels exhibit good weldability and good creep resistance at relatively high temperatures. Pressure containing castings for medium high temperature service.
	WCB	70,000	36,000	22	90 degree bend*	
A-217-59T	WC1	65,000	35,000	24	90 degree bend	A-217-59T steels are alloyed to give good creep resistance and high temperature properties. Pressure containing castings for high temperature service.
	WC4, WC5 WC6, WC9	70,000	40,000	20	90 degree bend	
	C5, C12	90,000	60,000	18	90 degree bend	
A-352-59T	LCB, LC1	65,000	35,000	24	15 ft-lb**	Ferritic steels with good notch ductility at temperatures from −50 to −150° F. Test temperatures for each grade: −50° F, LCB; −75° F, LC1; −100° F, LC2; −150° F, LC3. Pressure containing castings for service at low temperatures.
	LC2, LC3	65,000	40,000	24	15 ft-lb**	
A-356-58T	1	70,000	36,000	20	.....	Heavy walled ferritic carbon and low alloy castings for steam turbines. Wall thicknesses over 1 in. Cylinders, valve chests, throttle valves and similar castings.
	2	65,000	35,000	22	.....	
	3	80,000	50,000	18	.....	
	4	90,000	60,000	16	.....	
	5	70,000	40,000	22	.....	
	6	70,000	45,000	22	.....	
	7	70,000	40,000	22	.....	
	8	80,000	50,000	18	.....	
	9	95,000	60,000	15	.....	
	10	85,000	55,000	20	.....	

*Expected value only, no test required unless specified.
**Charpy keyhole notch impact test required at temperatures specified by customer.
Source: Steel Founders' Society of America.

GRAY IRON

Specification		Class	Tensile Min (psi)	Heat Treatment*	Properties and Typical Applications
ASTM A-48-60T ASA G25.1-1948 ASME S61-1948 AASHO M105-49 CSA S61-1948 Federal QQ-1-652a	All basically the same	20 25	20,000 25,000	2	Same as ASTM A190-47, ASA G27.1-1942 (See Page S-16) with minimum tensile requirement. Excellent machinability as annealed.
		30 35	30,000 35,000	1	Good mechanical properties with high machinability. Most commonly used grade for general machinery, valves, light compressor bodies, municipal castings, waterworks equipment.
		40 45	40,000 45,000	1	Machine tools, medium gear blanks, heavy compressors, motor blocks.
		50 60	50,000 60,000	1	Large castings for heavy service: Dies, hydraulic cylinders, machine tools, permanent molds, large gears, press frames.

(Continued on Page S-16)

FERROUS CASTINGS (continued)

Specification		Class	Tensile Min (psi)	Heat Treatment*	Properties and Typical Applications
ASTM A159-55 SAE spec. No. given in class column	Automotive castings	110	20,000	2	Miscellaneous soft iron castings in which strength and microstructure are not primary considerations.
		111	30,000	1	Small cylinder blocks, heads, pistons, clutch plates, oil pump bodies, gearboxes, clutch housings, lightweight brake drums.
		113	30,000	1	Brake drums and clutch plates for moderate service requirements where high-carbon iron is desired and heat checking is problem.
		114	40,000	1	Heavy duty drums and clutch plates where strength and resistance to heat checking are requirements.
		120	35,000	1	Automotive cylinder blocks, heads, flywheels, cylinder liners, pistons.
		121	40,000	1	Truck and tractor cylinder blocks, heads, heavy flywheels, tractor transmission cases, differential carriers.
		122	45,000	1	Diesel engine castings, liners, cylinders, pistons, heavy parts.
ASTM A190-47 ASA G27.1-1942		.. ..	....	2	Lightweight, thin section castings requiring good appearance, high machinability, close tolerances. Use where strength is not a prime requisite. Specific qualities usually established by sample.
ASTM A278-56		40 50 60	40,000 50,000 60,000	3 3 3	Pressure containing parts for use up to 650° F. Valve bodies, paper mill dryer rolls, chemical process equipment.
ASTM A319-53		I II III	Low 30,000 about 40,000	2 2 2	Nonpressure containing parts for elevated temperature. Stoker and firebox parts, grate bars, process furnace parts, ingot molds. I: Superior resistance to thermal shock. II: Average resistance to thermal shock; moderate tensile strength. III: High creep and rupture strength.
U.S. Navy 46-1-9		..	25,000	..	High alloy scale resisting castings. For resistance to corrosion of acid, caustic and salt, including concentrated brine.
Mil-G-858A		I II	25,000 25,000	.. ..	High alloy for resistance to corrosion, scaling, warpage, growth; use at elevated temperatures. Galley range tops; to resist acid, caustic, and salt.

Source: Gray Iron Founders' Society Inc.
*1. Hardenable by conventional, flame, or induction heat treatment. 2. Hardening not recommended. 3. Must be stress relief annealed.

ALLOY STEELS

Standard, Tentative Standard (TS) & Boron Open Hearth & Electric Furnace Steel—Bars, Billets, Blooms, Slabs

SAE or AISI Number	C	Mn	P Max	S Max	Si	Ni	Cr	Mo
1330	0.28–0.33	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1335	0.33–0.38	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1340	0.38–0.43	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1345	0.43–0.48	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
TS 14B35*	0.33–0.38	0.75–1.00	....	....	0.20–0.35	.....	.....	.....
3140	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	1.10–1.40	0.55–0.75	.....
E3310**	0.08–0.13	0.45–0.60	0.025	0.025	0.20–0.35	3.25–3.75	1.40–1.75	.....
4012	0.09–0.14	0.75–1.00	0.040	0.040	0.20–0.35	.....	.....	0.15–0.25
4023	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4024	0.20–0.25	0.70–0.90	0.040	0.035–0.050	0.20–0.35	.....	.....	0.20–0.30
4027	0.25–0.30	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4028	0.25–0.30	0.70–0.90	0.040	0.035–0.050	0.20–0.35	.....	.....	0.20–0.30
4037	0.35–0.40	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4042	0.40–0.45	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4047	0.45–0.50	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4063	0.60–0.67	0.75–1.00	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4118	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.40–0.60	0.08–0.15
4130	0.28–0.33	0.40–0.60	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4135	0.33–0.38	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4137	0.35–0.40	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4140	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
TS 4140*	0.38–0.43	0.80–1.05	....	....	0.20–0.35	.....	0.90–1.20	0.08–0.15
4142	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4145	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4147	0.45–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4150	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
TS 4150*	0.48–0.53	0.80–1.05	....	....	0.20–0.35	.....	0.90–1.20	0.08–0.15
4320	0.17–0.22	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	0.40–0.60	0.20–0.30
4337	0.35–0.40	0.60–0.80	0.040	0.040	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
E4337*	0.35–0.40	0.65–0.85	0.025	0.025	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
4340	0.38–0.43	0.60–0.80	0.040	0.040	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
E4340	0.38–0.43	0.65–0.85	0.025	0.025	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
4422	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.35–0.45
4427	0.24–0.29	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.35–0.45
4520	0.18–0.23	0.45–0.65	0.040	0.040	0.20–0.35	.....	.....	0.45–0.60
4615	0.13–0.18	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4617	0.15–0.20	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4620	0.17–0.22	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30

SAE or AISI Number	C	Mn	P Max	S Max	Si	Ni	Cr	Mo
4621	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4718	0.16–0.21	0.70–0.90	0.040	0.040	0.20–0.35	0.90–1.20	0.35–0.55	0.30–0.40
4720	0.17–0.22	0.50–0.90	0.040	0.040	0.20–0.35	0.90–1.20	0.35–0.55	0.15–0.25
4815	0.13–0.18	0.40–0.60	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
4817	0.15–0.20	0.40–0.60	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
4820	0.18–0.23	0.50–0.70	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
5015	0.12–0.17	0.30–0.50	0.040	0.040	0.20–0.35	.....	0.30–0.50	.....
50B40	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
50B44	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
5046	0.43–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.20–0.35	.....
50B46	0.43–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.20–0.35	.....
50B50	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
50B60	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
5115	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5120	0.17–0.22	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5130	0.28–0.33	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	.....
5132	0.30–0.35	0.60–0.80	0.040	0.040	0.20–0.35	.....	0.75–1.00	.....
5135	0.33–0.38	0.60–0.80	0.040	0.040	0.20–0.35	.....	0.80–1.05	.....
5140	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5145	0.43–0.48	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5147	0.45–0.52	0.70–0.95	0.040	0.040	0.20–0.35	.....	0.85–1.15	.....
5150	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5155	0.50–0.60	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5160	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
51B60	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
E50100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	0.40–0.60	.....
E51100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	0.90–1.15	.....
E52100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	1.30–1.60	.....
								V
6118	0.16–0.21	0.50–0.70	0.040	0.040	0.20–0.35	.....	0.50–0.70	0.10–0.15
6120	0.17–0.22	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	0.10 min
6150	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15 min
								Mo
8115	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	0.20–0.40	0.30–0.50	0.08–0.15
81B45	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.20–0.40	0.35–0.55	0.08–0.15
8615	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8617	0.15–0.20	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8620	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8622	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8625	0.23–0.28	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8627	0.25–0.30	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8630	0.28–0.33	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8637	0.35–0.40	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8640	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8642	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8645	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
86B45	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8650	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8655	0.50–0.60	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8660	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8720	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8735*	0.33–0.38	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8740	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8742	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8822	0.20–0.25	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.30–0.40
9255	0.50–0.60	0.70–0.95	0.040	0.040	1.80–2.20	.....	.....	.....
9260	0.55–0.65	0.70–1.00	0.040	0.040	1.80–2.20	.....	.....	.....
9262	0.55–0.65	0.75–1.00	0.040	0.040	1.80–2.20	.....	0.25–0.40	.....
E9310**	0.08–0.13	0.45–0.65	0.025	0.025	0.20–0.35	3.00–3.50	1.00–1.40	0.08–0.15
94B15	0.13–0.18	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B17	0.15–0.20	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B30	0.28–0.33	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B40	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
9840	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	0.85–1.15	0.70–0.90	0.20–0.30
9850	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	0.85–1.15	0.70–0.90	0.20–0.30
								Al
Standard Nitriding Steel	0.38–0.43	0.50–0.70	0.040	0.040	0.20–0.40	0.95–1.30	1.40–1.80	0.30–0.40

Source—American Iron & Steel Institute, 1957.

NOTES

1. TS denotes tentative standard steels.
2. Boron steels indicated by B can be expected to have 0.0005 per cent minimum boron content.
3. Grades with prefix E are manufactured by basic electric furnace process. All others are normally produced by basic open hearth process but may be made by basic electric furnace process with adjustments in phosphorus and sulfur.
4. Ranges and limits apply to steel not exceeding 200 sq in. cross-sectional area.
5. All chemical ranges and limits are subject to standard variations for check analysis over or under specification.

*No corresponding SAE number.

**SAE numbers do not have prefix E.

6. Phosphorus and sulfur limitations for each process:

Basic electric furnace	0.025% max
Basic open hearth	0.040% max
Acid electric furnace	0.050% max
Acid open hearth	0.050% max

7. Minimum silicon limit for acid open hearth or acid electric furnace alloy steel is 0.15 per cent.
8. Small quantities of certain elements in alloy steel are not specified or required. They are considered as incidental and may be present in these maximum amounts: Copper, 0.35%; nickel, 0.25; chromium, 0.20; molybdenum, 0.06.
9. Where sulfur content range is shown, it is indicative of resulfurized steel.

H-STEELS

Standard, Tentative Standard (TS) & Boron Open Hearth & Electric Furnace Steels—Bars, Billets, Blooms

SAE or AISI NUMBER	C	Mn	Si	Ni	Cr	Mo
1330–H	0.27–0.33	1.45–2.05	0.20–0.35	.....	.....	.....
1335–H	0.32–0.38	1.45–2.05	0.20–0.35	.....	.....	.....
1340–H	0.37–0.44	1.45–2.05	0.20–0.35	.....	.....	.....
TS 14B35–H	0.32–0.38	0.65–1.10	0.20–0.35	.....	.....	.....
3140–H	0.37–0.44	0.60–1.00	0.20–0.35	1.00–1.45	0.45–0.85	.....
3310–H	0.07–0.13	0.30–0.70	0.20–0.35	3.20–3.80	1.30–1.80	.....
4027–H	0.24–0.30	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4028–H*	0.24–0.30	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4037–H	0.34–0.41	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4042–H	0.39–0.46	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4047–H	0.44–0.51	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4063–H	0.59–0.69	0.65–1.10	0.20–0.35	.....	.....	0.20–0.30
4118–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.30–0.70	0.08–0.15
4130–H	0.27–0.33	0.30–0.70	0.20–0.35	.....	0.75–1.20	0.15–0.25
4135–H	0.32–0.38	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15–0.25
4137–H	0.34–0.41	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15–0.25
4140–H	0.37–0.44	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
TS 4140–H	0.37–0.44	0.70–1.20	0.20–0.35	.....	0.85–1.30	0.08–0.15
4142–H	0.39–0.46	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
4145–H	0.42–0.49	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
4147–H	0.44–0.51	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
4150–H	0.47–0.54	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
TS 4150–H	0.47–0.54	0.70–1.20	0.20–0.35	.....	0.85–1.30	0.08–0.15
4320–H	0.17–0.23	0.40–0.70	0.20–0.35	1.55–2.00	0.35–0.65	0.20–0.30
4337–H	0.34–0.41	0.55–0.90	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4340–H	0.37–0.44	0.55–0.90	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4520–H	0.17–0.23	0.35–0.75	0.20–0.35	.....	.....	0.45–0.60
E4340–H	0.37–0.44	0.60–0.95	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4620–H	0.17–0.23	0.35–0.75	0.20–0.35	1.55–2.00	.....	0.20–0.30
4621–H	0.17–0.23	0.60–1.00	0.20–0.35	1.55–2.00	.....	0.20–0.30
4718–H	0.15–0.21	0.60–0.95	0.20–0.35	0.85–1.25	0.30–0.60	0.30–0.40
4720–H	0.17–0.23	0.45–0.75	0.20–0.35	0.85–1.25	0.30–0.60	0.15–0.25
4815–H	0.12–0.18	0.30–0.70	0.20–0.35	3.20–3.80	.....	0.20–0.30
4817–H	0.14–0.20	0.30–0.70	0.20–0.35	3.20–3.80	.....	0.20–0.30
4820–H	0.17–0.23	0.40–0.80	0.20–0.35	3.20–3.80	.....	0.20–0.30
5046–H	0.43–0.50	0.65–1.10	0.20–0.35	.....	0.13–0.43	.....
50B40–H	0.37–0.44	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B44–H	0.42–0.49	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B46–H	0.43–0.50	0.65–1.10	0.20–0.35	.....	0.13–0.43	.....
50B50–H	0.47–0.54	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B60–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
5120–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5130–H	0.27–0.33	0.60–1.00	0.20–0.35	.....	0.75–1.20	.....
5132–H	0.29–0.35	0.50–0.90	0.20–0.35	.....	0.65–1.10	.....
5135–H	0.32–0.38	0.50–0.90	0.20–0.35	.....	0.70–1.15	.....
5140–H	0.37–0.44	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5145–H	0.42–0.49	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5147–H	0.45–0.52	0.60–1.05	0.20–0.35	.....	0.80–1.25	.....
5150–H	0.47–0.54	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5155–H	0.50–0.60	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5160–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.60–1.00	.....
51B60–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.60–1.00	V
6118–H	0.15–0.21	0.40–0.80	0.20–0.35	.....	0.40–0.80	0.10–0.15
6120–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.60–1.00	0.10 min
6150–H	0.47–0.54	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15 min
						Mo
81B45–H	0.42–0.49	0.70–1.05	0.20–0.35	0.15–0.45	0.30–0.60	0.08–0.15
8617–H	0.14–0.20	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8620–H	0.17–0.23	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8622–H	0.19–0.25	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8625–H	0.22–0.28	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8627–H	0.24–0.30	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8630–H	0.27–0.33	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8637–H	0.34–0.41	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8640–H	0.37–0.44	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8642–H	0.39–0.46	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8645–H	0.42–0.49	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
86B45–H	0.42–0.49	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8650–H	0.47–0.54	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8655–H	0.50–0.60	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8660–H	0.55–0.65	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8720–H	0.17–0.23	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8740–H	0.37–0.44	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8742–H	0.39–0.46	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8822–H	0.19–0.25	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.30–0.40
9260–H	0.55–0.65	0.65–1.10	1.70–2.20	.....	.....	.....
9262–H	0.55–0.65	0.65–1.10	1.70–2.20	.....	0.20–0.50	.....
9310–H	0.07–0.13	0.40–0.70	0.20–0.35	2.95–3.55	1.00–1.45	0.08–0.15
94B15–H	0.12–0.18	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B17–H	0.14–0.20	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B30–H	0.27–0.33	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B40–H	0.37–0.44	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
9840–H	0.37–0.44	0.60–0.95	0.20–0.35	0.80–1.20	0.65–0.95	0.20–0.30
9850–H	0.47–0.54	0.60–0.95	0.20–0.35	0.80–1.20	0.65–0.95	0.20–0.30

NOTES
1. TS denotes tentative standard steels.
2. Boron steels indicated by B can be expected to have 0.0005% min boron content.
3. Notes 4, 5, 6, 7, and 8 on Alloy Steels apply to H-Steels.

Source: American Iron & Steel Institute, 1958.
*Sulfur content 0.035-0.050%.

SPRING ALLOYS

Name or Trademark and Specification	Nominal Composition %*	Properties and Typical Uses
HIGH CARBON		
Music Wire ASTM A228-51 AMS-5112	C 0.70-1.00; Mn 0.20-0.60	Widely used for small springs. High tensile strength; stands high stresses. Temperature limit: 250° F. Torsion working stress 90,000-180,000 psi; bending working stress 150,000-350,000 psi.
MB Grade Oil Tempered ASTM A229-56	C 0.55-0.75; Mn 0.60-1.20	General purpose steel for coil springs where high performance of music wire is not needed, or in larger sizes than available in music wire. Not recommended for cyclic, impact loading, or use above 350° F. Torsion working stress 80,000-130,000 psi; bending working stress 120,000-250,000 psi.
MB Grade Hard Drawn ASTM A227-47	C 0.45-0.75; Mn 0.60-1.20	Cheapest spring steel for general purposes. Used where accuracy of loads and deflections not important. Temperature limit: 250° F. Torsion working stress 75,000-130,000 psi; bending working stress 100,000-200,000 psi.
MB Grade Soft or Untempered	C 0.55-0.75; Mn 0.60-1.20	Used in helical springs or wire forms where severe forming is required. May be obtained dead soft (annealed at final size) or with one or more draws after heat treatment. Hardened and tempered after fabrication.
HB Grade Soft, Hard Drawn, or Oil Tempered	C 0.71-0.85; Mn 0.60-0.90	Uses similar to MB grade. Tensile strengths higher than MB grade, but in the hard drawn condition are lower than music wire. Uses are about halfway between the two.
Extra HB Grade Soft or Oil Tempered	C 0.86-1.05; Mn 0.30-0.60	Applications same as HB grade.
Upholstery Grade ASTM A407-57T	C 0.45-0.70; Mn 0.60-1.20	Not suitable for mechanical springs. Intended specifically for use in manufacture of upholstery.
ASTM A417-57T	C 0.50-0.75; Mn 0.60-1.20	Spring constructions such as mattress springs, bed springs, furniture, and automobile seat springs.
FLAT HIGH CARBON		
Cold Rolled Flat Spring Steel, Hard Rolled or Annealed	C 0.48-0.65; Mn 0.60-0.90	Used for miscellaneous springs and washers. In annealed condition will withstand more severe deformation than the 0.65-0.80 carbon grade.
Cold Rolled Spring Steel, Tempered or Annealed	C 0.65-0.80; Mn 0.30-0.90	Most popular flat, cold rolled spring steel. Used for spring clips, flat springs, spiral springs.
Cold Rolled Spring Steel, Tempered or Annealed	C 0.90-1.05; Mn 0.30-0.50	Used principally for clock and motor springs. Can withstand higher stress than the 0.65-0.80 carbon grade. Used for instrument and flat springs that have limited forming requirements.
ALLOY STEELS		
Chromium AISI 5155 SAE 5155	C 0.50-0.60; Mn 0.70-0.90; Si 0.20-0.35; Cr 0.70-0.90	Automotive type leaf springs.
Chromium AISI 5160 SAE 5160	C 0.55-0.65; Mn 0.75-1.00; Si 0.20-0.35; Cr 0.70-0.90	Automotive type coil springs.
Chrome-Vanadium ASTM A60-49	C 0.48-0.53; Mn 0.70-0.90; Cr 0.80-1.10; Si 0.20-0.35; V 0.15 min	Hot rolled, chromium-vanadium steel bars used in the manufacture of springs.
Chrome-Vanadium ASTM A231-41 SAE 6150	C 0.45-0.55; Mn 0.60-0.90; Cr 0.80-1.10; Si 0.15-0.30; V 0.15 (0.18 desired)	Good for shock, impact loading, and temperatures to 425° F. Torsion working stress 100,000-130,000 psi; bending working stress 180,000-230,000 psi.
Silicon-Manganese ASTM A59-49 SAE 9260	C 0.55-0.65; Mn 0.70-1.00; Si 1.80-2.20	Used in flat leaf springs for trucks and as a substitute for more expensive steels. Not recommended in pretempered wire.
Chrome-Silicon ASTM A401-58 SAE 9254	C 0.50-0.60; Mn 0.50-0.80; Si 1.20-1.60; Cr 0.50-0.80	For highly stressed springs requiring long life that are subject to shock loading, such as recoil springs on guns. Can be heat treated to Rc 50-53. May be used up to 475° F. Torsion working stress 115,000-150,000 psi; bending working stress 190,000-240,000 psi.
Chrome-Moly-Nickel AISI 8650 ASTM A332-56 Grade 8650	C 0.48-0.53; Mn 0.75-1.00; Si 0.20-0.35; Ni 0.40-0.70; Cr 0.40-0.60; Mo 0.15-0.25	Developed as an alternate for chrome-vanadium SAE 6150. Used in large sections for hot formed springs in railroad cars.
Chrome-Moly-Nickel AISI 8655 ASTM A332-56 Grade 8655	C 0.50-0.60; Mn 0.75-1.00; Si 0.20-0.35; Ni 0.40-0.70; Cr 0.40-0.60; Mo 0.15-0.25	Uses same as for AISI 8650.
Chrome-Moly-Nickel AISI 8660 ASTM A332-56 Grade 8660	C 0.55-0.65; Mn 0.75-1.00; Si 0.20-0.35; Cr 0.40-0.60; Ni 0.40-0.70; Mo 0.15-0.25	Uses same as for AISI 8650.
VALVE SPRING STEELS		
High Carbon Valve Spring Wire ASTM A230-47	C 0.60-0.75; Mn 0.50-0.90; Si 0.12-0.30	Valve springs in automotive and aircraft engines and other springs requiring high fatigue properties. Uniform properties, smooth finish, and tensile strengths of 195,000-250,000 psi.
Chrome-Vanadium Valve Spring Wire ASTM A232-47 AMS-6450	C 0.45-0.55; Mn 0.60-0.90; Si 0.12-0.30; Cr 0.80-1.10; V 0.15-0.25	Automotive and aircraft valve springs. Stands high stresses, shock and impact loading up to 400° F, with long fatigue life.
STAINLESS STEELS		
Types 301 and 302	Ni 7.00-10.00; Cr 17.00-19.00; C 0.15 max	Furnished in reasonably high tensile strength with lower permeability than carbon steels. Magnetic when worked to spring temper. General purpose corrosion resistance uses. Can be used to 550° F. Torsion working stress 45,000-140,000 psi; bending working stress 60,000-260,000 psi.
Type 316	Ni 10.00-14.00; Cr 16.00-18.00; Mo 2.00-3.00; Mn 2.00; C 0.08 max	Addition of Mo increases corrosion resistance to most chemicals, particularly the halogens. Lower tensile than 302 for similar amounts of cold reduction. Torsion working stress 40,000-120,000 psi; bending working stress 55,000-220,000 psi.
17-7 PH (Armco)	Ni 7.00; Cr 17.00; C 0.07; Al 1.00	Good corrosion resistance. Can be used up to 700° F. Torsion working stress 134,000-160,000 psi; bending working stress 195,000-225,000 psi.
PH 15-7 Mo (Armco)	Ni 7.00; Cr 15.00; Mo 2.25; C 0.066; Al 1.10	
Types 410 and 420	Cr 12.00-14.00	Only used for springs in the heat treated condition. Hardened after forming. Not corrosion resistant unless polished.
AM 350	C 0.09; Mn 0.75; Si 0.35; Cr 16.65; Ni 4.50; Mo 2.85; N 0.10	Excellent stability under long time service up to 900° F.
AM 355	C 0.13; Mn 0.75; Si 0.35; Cr 15.50; Ni 4.50; Mo 2.85; N 0.10	Harden before or after forming.

(Continued on Page S-20)

SPRING ALLOYS (continued)

Name or Trademark and Specification	Nominal Composition %*	Properties and Typical Uses
COPPER-BASE ALLOYS		
Electrolytic Tough Pitch	Cu 99.90	Has best electrical conductivity of copper and copper-base alloys supplied in spring temper. Used in radio parts and electrical switches.
Gilding, 95%	Cu 95.00; Zn 5.00	Rolled strip supplied in spring temper.
Commercial Bronze, 90% Jewelry Bronze, 87.50% Red Brass, 85% Low Brass, 80%	Cu 90.00; Zn 5.00 Cu 87.50; Zn 12.50 Cu 85.00; Zn 15.00 Cu 80.00; Zn 20.00	Flat products and wire supplied in spring temper. Tensile strength increases and conductivity is slightly reduced with lower copper content.
Cartridge Brass, 70% ASTM B134-51 SAE 80	Cu 70.00; Zn 30.00	A hard-drawn material usually used in the spring-hard temper. Inexpensive, high electrical conductivity, low tensile strength. Used in flat stampings where sharp bends are needed.
Yellow Brass	Cu 65.00; Zn 35.00	Flat products and wire supplied in spring temper.
Phosphor Bronze, 5% (A)	Cu 94.00; Sn 3.50-5.80; P 0.03-0.35	Combines good strength, hardness, electrical conductivity, and corrosion resistance with low cost. Used for contact fingers in switches.
Phosphor Bronze, 8% (C)	Cu 92.00; Sn 7.00-9.00; P 0.03-0.35	Used for more severe service than the 5% alloy. Typical uses: Cotter pins, diaphragms, fuse clips, switch parts, wire brushes.
Phosphor Bronze, 10% (D)	Cu 90.00; Sn 9.00-11.00; P 0.03-0.35	Heavy bars and plates for severe compression, good wear, and corrosion resistance. Used for parts requiring extra spring qualities, greater resiliency, particularly in fatigue.
Nickel Silver, 55-18	Cu 55.00; Ni 18.00; Zn 27.00	The nickel silver alloys have a silvery white color that harmonizes with surroundings. Used for contact fingers. Good electrical conductivity, corrosion resistance.
Nickel Silver, 65-10	Cu 65.00; Ni 10.00; Zn 25.00	Better electrical conductivity than the 55-18 grade. Spring temper supplied in wire only.
Beryllium Copper ASTM B194-55 (flat springs) ASTM B196-52 (round sections)	Cu 98.00; Be 2.00	Electrical switches and components. Can be formed in annealed condition and precipitation hardened to get high tensile strength.
High-Silicon Bronze (A) ASTM B97	Cu 94.80; Si 2.80-3.50; can have small amounts of Fe, Zn, Mn, or Ni	Silicon bronze has excellent resistance to corrosion.
NICKEL-BASE ALLOYS		
Monel Alloy QQ N-281a (Cl. A) MIL-N-894 C (Cl. A)	Ni 67.00; Cu 30.00	Resists sea water corrosion, is nearly nonmagnetic. Often used in food and beverage equipment. Torsion working stress 50,000-63,000 psi; bending working stress 88,000-107,000 psi. Temperature range: —100 to 400° F.
"K" Monel Alloy QQ-N-286a MIL-W-4471 (Comp. A) MIL-N-17506A (Cl. A)	Ni 63.00-70.00; Al 2.00-4.00; Ti 0.25-1.00; Cu bal	A precipitation hardening alloy. Age hardening gives a higher tensile strength than Monel. Nonmagnetic and can be used at temperatures of —100 to 450° F at working stresses under 45,000 psi. Torsion working stress 60,000-70,000 psi; bending working stress 110,000-120,000 psi.
Inconel Alloy QQ-W-390a	Ni 72.00 min; Cr 14.00-17.00; Fe 6.00-10.00	Nonmagnetic, good corrosion resistance, stands temperatures up to 650° F. Useful at subzero temperatures. Used in steam valves, regulating valves, springs in boilers, compressors, turbines, jet engines. Torsion working stress 55,000-80,000 psi; bending working stress 110,000-135,000 psi.
Inconel "X" Alloy AMS-5698 AMS-5699	Ni 70.00 min; Cr 14.00-17.00; Fe 5.00-9.00; Ti 2.00-2.50; Al 0.40-1.00; Cb 0.70-1.20	A precipitation hardening alloy. Nonmagnetic and can be used in larger sections than Inconel at higher tensile strengths. May be used up to 1100° F, depending on design stresses. Useful at subzero temperatures. Torsion working stress 55,000-85,000 psi; bending working stress 110,000-135,000 psi.
COBALT-BASE ALLOYS		
Elgiloy 8 J Alloy Durapower Cobenium	Co 40.00; Cr 20.00; Ni 15.00; Mo 7.00; Mg 2.00; C 0.15; Be 0.04; Fe bal	Used for power, compression, extension, torsion and leaf springs. Fatigue and set resistant. High corrosion resistance, nonmagnetic, low hysteresis and drift. Torsion working stress 125,000 psi; bending working stress 250,000 psi. For applications from —85 to 700° F.
Dynavar Dynamet	Ni 13.00; Fe 17.00; Cr 2.00; Co 42.00; W 2.50	Suitable for subzero and up to 750° F temperatures, provided torsional stresses are kept under 75,000 psi. Used in watches and instruments for springs and diaphragms.
Havar	Co 42.00; Cr 20.00; Ni 13.00*	Instrument springs, drive bands, and magnetic shields.
S 816	Co 43.00; Ni 20.00; Cr 20.00; Mo 4.00; W 4.00; Cb 4.00; Fe 3.00	Similar to Elgiloy and Armco 17-7 PH with better high temperature properties. Used for instrument and watch springs.
Haynes Alloy No. 25	Co 51.50; W 15.00; Ni 10.00; Cr 20.00; Fe 3.00 max	Useful for springs operating at temperatures of 600 to 900° F.
CONSTANT MODULUS ALLOYS		
Ni-Span-C Elinvar Extra	Ni 41.00-43.00; Cr 4.90-5.50; Ti 2.10-2.50; Fe bal	Precipitation hardening alloy. Excellent thermoelastic characteristics over the range of —50 to 150° F. Torsion working stress 60,000 psi; bending working stress 15,000-110,000 psi. Used in control, timing, and measuring equipment.
Iso-Elastic	Ni 35.00-37.00; Cr 7.00-7.60; Mo 0.35-0.70; Fe bal	Used principally in dynamometers, instruments, and food weighing scales. Its temperature compensating characteristics meet requirements of national and state boards of weights and measures. Torsion working stress 40,000-60,000 psi; bending working stress 90,000-100,000 psi.

*Only major elements listed.

MAGNESIUM

Alloys ASTM No.	Nominal Composition % (magnesium is rem.)	Properties
SAND AND PERMANENT MOLD CASTINGS		
AZ63A	Al 6.0; Zn 3.0; Mn 0.15	Maximum toughness or ductility plus moderately high yield strength. Used in heat treated and aged condition.
AZ81A	Al 7.6; Zn 1.0; Mn 0.20	High ductility plus yield strength comparable to AZ63A-T4. Used in heat treated condition.
AZ91C	Al 8.7; Zn 0.7; Mn 0.20	Properties between AZ63A and AZ92A. Used in heat treated and aged condition.
AZ92A	Al 9.0; Zn 2.0; Mn 0.15	Maximum yield strength plus good pressure tightness. Used in heat treated and aged condition.
AM100A	Al 10.0; Mn 0.15	Similar to AZ92A. Permanent mold casting mostly. Used in heat treated and aged condition.

Alloys ASTM No.	Nominal Composition % (magnesium is rem.)	Properties
ZE41A	Zn 4.0; R.E. 1.2; Zr 0.7	Good strength and castability. Used in aged condition.
ZK51A	Zn 4.6; Zr 0.7	High ductility plus yield strength. Used in aged condition.
ZK61A	Zn 5.7; Zr 0.7	Higher yield strength than ZK51A. Used in heat treated and aged condition.
ZH62A	Zn 5.7; Th 1.8; Zr 0.7	High ductility and yield strength. Good creep properties to 350° F. Used in aged condition.
QE22A	Ag 2.5; Di 2.0; Zr 0.7	High yield strength and good creep properties to 350° F. Used in heat treated, quenched, and aged condition.
EK31XA	Di 3.2; Zr 0.6	High yield strength and good creep properties to 500° F. Used in heat treated, quenched, and aged condition.
EK30A	R.E. 3.0; Zr 0.35	For elevated temperatures (350-500° F). Used in heat treated and aged condition.
EK41A	R.E. 4.0; Zr 0.6	For elevated temperatures (350-500° F). Used in heat treated and aged condition.
EZ33A	R.E. 3.0; Zn 2.7; Zr 0.7	For elevated temperatures (350-500° F). Used in aged condition.
HK31A	Th 3.0; Zr 0.7	For elevated temperatures (500-700° F). Used in heat treated and aged condition.
HZ32A	Th 3.0; Zn 2.1; Zr 0.7	For elevated temperatures (500-700° F). Used in aged condition.
K1A	Zr 0.7	High damping properties.
DIECASTINGS		
AZ91A	Al 9.0; Zn 0.7; Mn 0.20; Cu 0.10 max	Specification grade. Good strength, ductility, and castability.
AZ91B	Al 9.0; Zn 0.7; Mn 0.20; Cu 0.30 max	Standard grade. Good strength, ductility, and castability.
HM11XA	Th 1.2; Mn 1.2	For elevated temperatures (up to 800° F).
K1A	Zr 0.7	High damping properties.
AM20XA	Al 1.6; Mn 0.35	Good elongation and thermal conductivity.
FORGINGS AND EXTRUSIONS		
M1A	Mn 1.5	Used where stress relief after welding is not possible and strength requirements not severe.
AZ31B	Al 3.0; Zn 1.0; Mn 0.45	Most common extrusion alloy. Has moderate strength and good formability.
AZ61A	Al 6.5; Zn 1.0; Mn 0.30	Has improved strength over AZ31B, but not as formable.
AZ80A	Al 8.0; Zn 0.5; Mn 0.25	Has improved strength over AZ61A, but less ductility. Can be aged.
ZK21A	Zn 2.3; Zr 0.6	Has good strength and is weldable without need for stress relief. (Available as extrusions only.)
ZK60A	Zn 5.7; Zr 0.55	High strength and toughness. Used mostly in aged condition.
ZK60B	Zn 6.2; Zr 0.55	Higher strength than ZK60A. Extrusions made from pellets rather than billets. (Available as extrusions only.)
EK31XA	Di 3.2; Zr 0.6	For elevated temperatures (up to 500° F). Used in heat treated, quenched, and aged condition. (Available as forgings only.)
HM21A	Th 2.0; Mn 0.5	For elevated temperatures (500-700° F). Used in aged condition. (Available as forgings only.)
HM31A	Th 3.0; Mn 1.5	For elevated temperatures (up to 800° F). (Available as extrusions only.)
A3A	Al 3.0	Low neutron absorptivity. Rapid decay of induced radioactivity.
SHEETS AND PLATES		
AZ31B	Al 3.0; Zn 1.0	Most common sheet alloy. Good formability and weldability.
ZE10A	Zn 1.2; R.E. 0.2	Similar to AZ31B. Does not need stress relief after welding.
HK31A	Th 3.0; Zr 0.7	For elevated temperatures (up to 500° F).
HM21A	Th 2.0; Mn 0.5	For elevated temperatures (500-800° F).
A3A	Al 3.0	Low neutron absorptivity. Rapid decay of induced radioactivity.

COPPER WROUGHT ALLOYS

As specified by the Copper & Brass Research Association

Alloy and Nominal Composition %[1]	Forms[2]	Machinability[3]	Properties and Applications
COPPERS:			
Electrolytic tough pitch (Cu 99.90 min; O 0.04)	R,D,S,W,T	20	Electrical, thermal conductor. Radiators, wire flashing.
Deoxidized (Cu 99.90 min; P 0.02)	R,D,S,T	20	Forming, bending good. Plumbing, refrigeration, oil lines.
Oxygen-free copper (Cu 99.92 min)	R,D,S,W,T	20	Deep drawing. Glass-to-metal seals, electronics, bus bars.
BRASSES—Nonleaded:			
Gilding, 95% (Cu 95; Zn 5)	R,W	20	High polish; base for gold plate. Jewelry, emblems, medals.
Commercial bronze, 90% (Cu 90; Zn 10)	R,D,W,T	20	For cold working. Compacts, lipstick cases, screws.
Jewelry bronze, 87.5% (Cu 87.5; Zn 12.5)	R,W	30	Base for gold plate, Zippers, plaques, chains, jewelry.
Red brass, 85% (Cu 85; Zn 15)	R,W,T	30	Resists corrosion. Heat exchangers, trim, conduit, dials.
Low brass, 80: Zn 20)	R,W	30	For deep drawing. Bellows, musical instruments, dials.
Cartridge brass, 70% (Cu 70; Zn 30)*	R,D,W,T	30	Good ductility, strength. Cartridge cases, springs, pins.
Yellow brass (Cu 65; Zn 35)	R,D,W	30	Cold workability and corrosion resistance. Lamps, hinges.
Muntz metal (Cu 60; Zn 40)	R,D,T	40	High strength, low ductility. Condenser plates, forgings.
LEADED BRASSES:			
Leaded coml. bronze (Cu 89; Pb 1.75; Zn 9.25)	R,D,S	80	Screw machine parts, screws, pickling crates, buckles.
Low leaded brass (tubing) (Cu 66; Pb 0.5; Zn 33.5)	T	60	Good machinability, moderate cold workability. J-bends, pipe, fuse parts, pump liners, trap tubes.
Low leaded brass (Cu 65; Pb 0.5; Zn 34.5)	R	60	Hardware (butts, hinges, sink strainers), watch backs.
Medium leaded brass (Cu 65; Pb 1; Zn 34)	R,D,S,W	70	Hardware (butts, gears) clock plates, dials, nuts.
High leaded brass (tubing) (Cu 66; Pb 1.6; Zn 32.4)	T	80	Fabricated by machining, piercing, punching. General purpose screw machine products.
High leaded brass (Cu 65; Pb 2.0; Zn 33.0)	R,D	90	Free machining with good blanking properties. Nameplates, keys, lock parts, gears, clock and watch parts.
Extrahigh leaded brass (Cu 63; Pb 2.5; Zn 34.5)	R	100	For blanking, machining, piercing, stamping; clock plates, nuts, clock and watch backs, clock gears, wheels.
Free-cutting brass (Cu 61.5; Pb 3; Zn 35.5)*	R,D,S	100	High speed screw machine parts. Gears, pinions, drilling.
Leaded Muntz metal (Cu 60; Pb 0.6; Zn 39.4)	R	60	Improved machinability. Condenser tube plates.
Free-cutting Muntz metal (Cu 60; Pb 1; Zn 39)	T	70	Improved machinability. Automatic screw machine parts.
Forging brass (Cu 59; Pb 2; Zn 39)	R,D,S	80	Plastic when hot. Forgings, pressings of all kinds.
Architectural bronze (Cu 57; Pb 3; Zn 40)	D,S	90	For forging, free machining. Extrusions, moldings, trim.
TIN & ALUMINUM BRASSES:			
Inhibited admiralty (Cu 71; Zn 28; Sn 1)	R,W,T	30	Strength, ductility, corrosion resistance. Condenser, heat exchanger tubes and plates; auto aerials, marine uses.
Naval brass (Cu 60; Zn 39.25; Sn 0.75)*	R,D,S,T	30	Marine uses, condenser plates, shafts, valve stems.
Leaded naval brass (Cu 60; Pb 1.75; Zn 37.5; Sn 0.75)*	R,D,S	70	Like free-cutting brass with more corrosion resistance.
Manganese bronze (A) (Cu 58.5; Fe 1.4; Zn 39.0; Sn 1; Mn 0.1)	R,D,S	30	Wear resistance, high strength. Clutch discs, pump rods, valve stems and bodies, coal screens, condenser plates.
Aluminum brass (Cu 76; Zn 22; Al 2)	T	30	Resists impingement. Condenser and heat exchanger tubes.

(Continued on Page S-22)

COPPER WROUGHT ALLOYS (continued)

Alloy and Nominal Composition %[1]	Forms[2]	Machinability[3]	Properties and Applications
PHOSPHOR BRONZES (Tin Bronzes)*:			
Phosphor bronze, 5% (A) (Cu 95; Sn 5)	R,D,S,W,T	20	High tensile, resists corrosion, season cracking. Bourdon tubing, diaphragms, switch parts, washers, springs.
Phosphor bronze, 8% (C) (Cu 92; Sn 8)	R,D,S,W	20	For more severe conditions than above.
Phosphor bronze, 10% (D) (Cu 90; Sn 10)	R,D,S,W	20	Extra spring qualities, resists fatigue. Expansion plates.
Phosphor bronze, 1.25% (E) (Cu 98.75; Sn 1.25; P trace)	R,W	20	Good hot working properties but requires careful control. Low duty contacts and springs, hose, cold heading stock.
Free-cutting Phosphor Bronze (Cu 88; Pb 4; Zn 4; Sn 4)	R,D,S	80	Good cold workability, improved machinability. Bearings, bushings, gears, pinions, shafts, thrust washers, valve parts.
CUPRO-NICKEL AND NICKEL SILVERS:			
Cupro-nickel, 30% (Cu 70; Ni 30)	R,D,T	20	Strength, ductility, corrosion resistance. Condensers, meters, plates, heat exchanger tubing, salt water tubing.
Cupro-nickel, 10% (Cu 88.7; Fe 1.3; Ni 10)	R,T	20	Resists salt water. Condenser tubing and plates, pipe.
Nickel silver, 65-18 (Cu 65; Zn 17; Ni 18)	R,D,W	20	Deep drawing, resists tarnish. Zippers, flatware.
Nickel silver 55-18 (Cu 55; Zn 27; Ni 18)	R,D,W	30	Spring stock, resists fatigue. Springs, diaphragms.
Nickel silver, 65-15 (Cu 65; Zn 20; Ni 15)	R	20	Resists tarnish; hollow ware, nameplates, camera parts.
Nickel silver, 65-12 (Cu 65; Zn 23; Ni 12)	R,D,W	20	Deep drawing. Hollow ware, slide fasteners, trim.
Nickel silver, 65-10 (Cu 65; Zn 25; Ni 10)	R,D,W	20	Similar to above. Screws, flatware, platers' bars.
SILICON BRONZES (Copper-Silicon Alloys):			
High-silicon bronze A (Cu 94.8 min; Si 3)	R,D,S,W,T	30	Corrosion resistance of copper; physicals of mild steel. Hydraulic lines, tanks, bolts, screws, pole line hardware.
Low-silicon bronze B (Cu 96.0 min; Si 1.5)	R,D,S,W,T	30	Cold headed bolts, nuts, screws; clamps, cotter pins.

1. Only major elements listed.
2. Abbreviations: R—Rolled flat products. D—Rod and drawn flat products. T—Tubing. S—Shapes. W—Wire (except flat).
3. Basis: Free-cutting brass=100.

* This grade is also covered by an ASTM specification.

COPPER ALLOYS

Special wrought alloys not listed in the Copper & Brass Research Association's Manual of Standard Alloys

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
Boron Deoxidized Copper	1	Cu 99.98; B 0.02	Strip, wire, rods, bars—High conductivity deoxidized copper for electrical apparatus.
Lithium Deoxidized Copper	16	Cu 99.98; Li 0.004	Tubes and pipe. High electrical conductivity.
High-Thermo (Mod. Electrolytic Tough Pitch)	10	Cu 99.90 (plus small quantity of an element added to increase resistance to annealing)	Wire, bars, commutator section stock—High conductivity electrical uses, as in transmission lines, bus bars, commutator segments, where greater retention of high tensile is desired at temperatures that normally soften electrolytic copper.
Silver Bearing Copper	9	Cu 99.9, Ag 0.028	Electrical applications.
Zirconium Copper	1, 4	Cu 99.88; Zr 0.12	Rods—Soldering iron tips, resistance welding wheels and electrodes, miscellaneous current carrying parts, high temperature uses.
Sulfur Copper	1, 4, 12	Cu 99.7; S 0.3	Rods—Electrical parts, welding torch tips, soldering iron tips.
Phosphorized Arsenical Copper	1, 4, 12	Cu 99.68; P 0.02; As 0.30	Tubes—Condenser and heat exchanger tubes.
Tellurium Copper	1, 4, 6, 7, 12, 13	Cu 99.50; Te 0.50; P 0.007	Rods, bars, extrusions, die-pressed forgings—Gas cutting torch and welding tips, screw machine and other parts requiring high conductivity.
Chromium Copper	1, 2, 7	Cu 99.0; Cr 1.00	Rods, bars, shapes, forgings, sheets, strip, castings—Spotwelding tips, seamwelder rolls, flashwelding dies, electrical contacts, Properzi wheels, commutator segments, rotor bars, plating rolls, electrodes.
Cadmium Copper	1, 4	Cu 99.00; Cd 1.00	Sheets, strip, plates, wire, rods, bars—Electrical conductors, electrodes for resistance welding.
Leaded Copper	1	Cu 99.00; Pb 1.00	Rods and bars—High conductivity screw machine products.
Deoxidized Copper 129	1	Cu 98.99; Pb 1.00; B 0.01	Rods and bars, high conductivity screw machine products.
Phosnic Bronze Nickel-Phosphorus Bronze	6	Cu 98.65; Ni 1.10; P 0.25	Rods, wire, strip—Rivets, screws, springs, electrical parts.
Cadmium Bronze	1	Cu 98.60; Sn 0.60; Cd 0.80	Sheets, strip, plates, wire, rods, bars—Wire and cable for electrical conductors.
Telnic Bronze (Nickel-Phosphorus Bronze)	6	Cu 98.15; Ni 1.10; Te 0.50; P 0.25	Rods—Forgings and screw machine parts requiring high strength, good cvonductivity.
Herculoy 421 (Silicon Bronze B)	12	Cu 98; Si 1.75; Mn 0.25	Sheets, strip, plates, rods, forgings.
Leaded Nickel Copper, 831	1	Cu 97.80; Pb 1.00; Ni 1.00; P 0.20	Rods—Electrical equipment, high conductivity screw machine products.
Nickel-Silicon Copper	1, 4, 6	Cu 97.5; Ni 1.9; Si 0.6	Rods, wire, bars—Pole line hardware switch gear, cold formed nuts, bolts, electrical equipment.
Olympic-Type B	6	Cu 97.50; Si 1.50; Zn 1.00	Wire, rods—Bolts and nuts.
Cobalt Beryllium Copper 900	7	Cu 97; Co 2.6; Be 0.4	Resistance welding tips, welding wheels, etc.
Herculoy 420 (Silicon Bronze A)	12	Cu 96; Si 3; Mn 1	Sheets, strip, plates, rods, forgings.
Olympic-Type A	6	Cu 96.00; Si 3.00; Zn 1.00	Sheets, strip—Bearing plates, evaporators, certain marine hardware, special tanks.
Leaded Silicon Bronze	1	Cu 95.60; Pb 0.40; Si 3.00; Mn 1.00	Rods—Screw machine products.
Calsun Bronze, 951	1	Cu 95.50; Sn 2.00; Al 2.50	Wire, rods, bars—Wire and cable for electrical conductors.
Western Bronze, 86	9	Cu 95.0; Zn 4.0; Sn 1.0	Electrical spring contacts, fuse clips, electrical parts.
Aluminum Bronze, 5%	1, 12	Cu 95.00; Al 5.00	Tubes, rods, bars, sheets, strip, plates, wire—Condenser and heat exchanger tubes, foreign coinage, architectural decoration to imitate gold.
Aluminum Bronze, 53	4	Cu 94.25; Al 5.50; As 0.25	Tube condenser and heat exchanger.
Ambronze, 474	1	Cu 94.97; Zn 4.00; Sn 1.00; P 0.03	Sheets, strip, plates, wire—Electrical switch parts and springs.
Leaded Phosphor Bronze, (B)-379	1	Cu 93.90; Sn 5.00; Pb 1.00; P 0.10	Strip, wire, rods, bars, tubes—Screw machine products.
Brazing Bronze, 222	9	Cu 93.00; Zn 4.70; Fe 2.30	Sheets, strip—Retains fine grain size up to about 1600-1700° F. Used for furnace brazing, electrical applications such as circuit breaker arms, terminals.
Cupro Nickel, 142	9	Cu 93; Ni 7.0	Fuse components, resistance springs.
Ambronze, 404	1	Cu 92.00; Zn 7.00; Sn 1.00	Strip, rods, bars—Spring and contact applications in electrical equipment and hardware.
Tin Brass, 2%	7, 8, 11, 13	Cu 92; Sn 2; Zn 6	Strip—General spring and contact applications in electrical and hardware fields.

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
Aluminum Bronze, 8%	1	Cu 92; Al 8	Sheets, strip, plates, wire, rods, bars—Valve stems, coins, medallions, plaques.
Duronze, 708	4	Cu 91.43; Al 6.75; Si 1.75; As 0.07	Rods, wire, bars, forgings. Excellent hot working capacity. May be hot formed without loss of strength when returned to normal temperatures. Uses include valve materials, high strength, corrosion resistant fasteners.
Aluminum Bronze, 7%	2, 12	Cu 91; Al 7; Fe 2	Sheets, plates, extruded rods, tubes, pipe, shapes—Mechanical and processing fabrications, conveyors, liners, heads, slides, gibs, and wear strips.
Aluminum Silicon Bronze	1, 2, 4, 6, 7, 12	Cu 91; Al 7; Si 2	Rods, bars—Valve stems and parts, wire cable connector parts, bolts and nuts, hot forged parts, marine hardware, gears, pinions. Good corrosion resistance.
Nickel Leaded Commercial Bronze	1, 6, 15	Cu 90.25; Zn 6.90; Pb 1.75; P 0.10; Ni 1.00	Rods, bars, tubes—Pole line hardware and other parts subject to outdoor exposure. Rods—Machined nuts, screw machine parts.
Tin Brass, 1%	8, 13, 17	Cu 90.00; Sn 1.00; Zn 9.00	Strip—Special springs, contacts, jewelry, sockets, switch parts for electrical and hardware field.
Aluminum Bronze	4, 7, 17	Cu 90; Al 9; Fe 1.00	Rods, wire, welding rods. Excellent hot working capacity, high strength with good corrosion resistance. Uses include valve parts, fasteners, forgings.
Tin Brass, 0.5%	9, 13	Cu 90.00; Sn 0.50; Zn 9.50	Sheets, strip—Bearing alloy for bushings, bearings, clutch plates, thrust washers, jewelry, bezels, weather strip.
Tin Brass, 1.75%	9	Cu 90.00; Zn 8.25; Sn 1.75	Sheets, strip—Radio tube socket contacts, fuse clips, contact springs, lock washers, solderless connectors, jewelry, coins, electric fan blades, medallions.
Scovill, 215	13	Cu 90; Pb 2; Zn 8	Rods—High conductivity bronze.
Hardware Bronze "B" 89	4	Cu 89.50; Zr 8.50; Pb 2.00	Rods, wire. Rich bronze color, good machinability and corrosion resistance. Uses include fasteners, connectors, hardware, etc.
Leaded Bearing Bronze, 116	9	Cu 89; Zn 2.75; Sn 4.00; Pb 4.00	Sheets, strip—Bearings and bushings in automobiles, aircraft.
Avialite, 915	1	Cu 89.25; Sn 0.40; Al 9.25; Ni 0.50; Fe 0.60	Rods, bars, die-pressed forgings—pickling crates. Used where strength and resistance to corrosion at high temperatures are required as in parts for internal combustion engines.
Contact Bronze, 92 (Tin Brass)	4	Cu 89.00; Sn 1.80; Zn 8.20	Strip—Electrical and radio spring applications.
Cupro Nickel, Western Brass 144	9	Cu 88.5; Ni 11.5	Fuse components.
Ambronze, Chain Bronze	1, 9, 17	Cu 88; Zn 11; Sn 1	Strip, wire, tubes—Spring and switch parts for electrical apparatus and hardware.
Ni-Vee Bronze	14	Cu 88; Ni 5; Sn 5; Zn 2	Strip, rods—Valve stem fasteners, hardware. Heat treatable alloy.
Aluminum Bronze 224-C	7	Cu 87.5; Al 9.75; Fe 2.75	High strength, acid resistance, corrosion resistance, resistance to oxidation at high temperatures, lightweight. Aviation valve seats, valve guides. More resistant to corrosion cracking under load than Cu-Zn alloys.
Tin Brass, 2%	1, 4, 5, 9, 10, 17	Cu 88; Sn 2; Zn 10	Strip—Cold workable alloy, characterized by its toughness, ductility, spring quality, high tensile strength, and high electrical conductivity.
Free Cutting Phosphor Bronze 819	4	Cu 87.8; Sn 4.0; Pb 4.0; Zn 4.0; P 0.2	Rods. Similar in composition to cast leaded red brass only in wrought form. Good corrosion resistance, and machinability.
High Strength Bronze 90 Hardware Bronze "B"	4	Cu 87.50; Zn 7.43; Pb 2.00; Ni 1.00; P 0.07	Rods. Age hardenable, formable, machinable high strength alloy. Uses include corrosion resistant fasteners, valve, and pump parts.
Led-O-Loy	5	Cu 87; Sn 2; Pb 2; Zn 9; P 0.05	Strip—Machinability combined with strength and resistance to wear. For meter and gage components, bearings, washers, etc.
Ambronze, 422 Spring Bronze	1, 13	Cu 87; Sn 2; Zn 11	Strip, wire, rods, bars—Spring and switch parts for electrical apparatus and hardware.
Aluminum Bronze	2	Cu 87.00; Al 9.50; Fe 3.20	Extruded solid and hollow rounds, shapes—Gears, small worm wheels, bushings, valve seats, guides.
Aluminum Bronze	9	Cu 87; Zn 7; Al 4; Fe 2	Sheets, strip—Bearings, bushings, thrust washers.
Brmcolloy, 300	5	Cu 86; Sn 2; Zn 12	Strip—High fatigue resistance for electrical contacts.
Brmcolloy, 200	5	Cu 86; Sn 1; Zn 13	Strip—Sash chain, electrical contacts, switch parts, and fuse clips.
Jewelry Bronze, ½%	5, 12	Cu 86.00; Sn 0.50; Zn 13.50	Strip—Jewelry chain, switch, and relay components.
Aluminum Bronze	2, 7	Cu 85.50; Al 10.50; Fe 3.50	Extruded solid and hollow rounds, shapes—Bushings, bearings, worms and worm wheels, valve seats and guides, hydraulic valve parts, plungers, pump rods, guide-pin bushings, gibs, slides.
Manganese Red Brass, 507	1	Cu 85; Zn 14; Mn 1	Sheets, strip—Resistance spotwelding and seamwelding.
Hardware Bronze	1, 4	Cu 85.00; Zn 13.25; Pb 1.75	Rods, bars—Hardware, screw machine products.
Glo-Ray	8	Cu 85; Zn; 14.50; Sn 0.50	Jewelry and allied fields, where color and strength are factors.
Silicon Red Brass, 1027	1	Cu 82; Zn 17; Si 1	Sheets, trip, plates, wire—Resistance welding.
Ambraloy, 917	1	Cu 82; Al 9.50; Mn 1; Ni 5; Fe 2.50	Plates, rods, bars, die-pressed forgings—Tube sheets for heat exchangers.
Manganese Red Brass	4	Cu 81.00; Mn 1.25; Zn 17.75	Strip—Spotwelding and seamwelding.
High-Silicon Brass	4, 12, 15	Cu 81; Si 4; Zn 15	Rods, diecastings, forgings—Valve parts, pole line hardware.
Nickel Aluminum Bronze	2, 7	Cu 81; Ni 5.0; Al 10; Fe 2.5; Mg 1.0	Heat treatable. High physical properties. Used in aviation industry for spacers, gears. Used in operation of retractable landing gear. More resistant to corrosion cracking under load than copper-zinc alloys.
Aluminum Brass (Revalon) 435	12	Cu 76; Zn 22; Al 2; As 0.05	Tubes for condenser and heat exchanger use.
18% Ni Silver, Grade A	9	Cu 72; Zn 10; Ni 18	Deep drawing, fishing rod ferrules, trophies, musical instruments.
12% Ni Silver, Western 176	9	Cu 70.0; Zn 18.0; Ni 12.0	Fishing reels & tackle, musical instruments, coins, nameplates, slide fasteners.

(Continued on Page 24)

COPPER ALLOYS (continued)

Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
Manganese Brass	1, 4, 9, 12	Cu 70.00; Zn 28.90; Mn 1.10	Sheets, strip—Same physical characteristics as cartridge brass except for lower electrical conductivity, permitting easier spot and seamwelding.
Alloy 77	4	Cu 69.50; Zn 30.45; Hg 0.05	Tube. Corrosion resistant antibiofouling alloy for condenser and heat exchanger applications.
High Brass, Western 33	9	Cu 68.5; Zn 31.5	Drawn shells, radiator lock seam tubing, tanks, ferrules, hardware.
10% Ni Silver		Cu 66.5; Zn 23.5; Ni 10.0	Arch supports, slide fasteners, fishing tackle.
Manganese Bronze (High Tensile, Grade B)	7, 15	Cu 65; Zn 23; Al 5.0; Fe 3.0; Mg 4.0	High strength, toughness, resistant to shock wear and salt water corrosion. Withstands high hydraulic pressures. Used for rollers, rotors, valve stems. Nonmagnetic.
Leaded Ni Silver		Cu 64.5; Zn 27.9; Ni 7.9; Pb 1.5	Keys, watch plates, lock parts, good corrosion resistance.
Leaded Ni Silver		Cu 64.5; Zn 24.0; Ni 12.0; Pb 1.5	Keys, watch plates, wheels, lock plates.
Leaded Brass, Western 62	9	Cu 64.00; Zn 35.0; Pb 1.0	Key stock, maximum machinability for 1% Pb alloy, builders' hardware, electrical parts.
Leaded Brass	6, 9, 15	Cu 62.5; Pb 2.0; Zn 35.5	Sheets, strip, rods—Screw machine products involving secondary operations such as flanging, knurling, roll threading, spinning, and staking.
Spinning Brass—R-65	3	Cu 62.5; Pb 1.25; Zn 36.25	Rods—Combines free machining with excellent cold working properties, such as spinning, flaring, and swaging.
Leaded Ni Silver, Western Brass 131		Cu 61.5; Zn 27.0; Ni 10.0; Pb 1.5	Substitute for high brass.
Thread Rolling-Free Cutting Brass, Clock Brass	7, 9	Cu 61.00; Pb 1.75; Zn 37.25	Rods—Screw machine products. Sheets—Keys, clock and watch parts.
Nonleaded Bearing Alloy	3, 7	Cu 61.00; Mn 2.50; Si 1.00; Zn 35.50	Rods—Screw machine products, cams.
Medium-Leaded Bearing Alloy, 602	7	Cu 61.00; Mn 2.50; Si 1.00; Pb 1.00; Zn 34.50	Rods—Screw machine products, shaft bushings.
High-Leaded Bearing Alloy, 604	7	Cu 61.00; Mn 2.50; Si 1.00; Pb 2.50; Zn 33.00	Rods—Screw machine products.
Low-Leaded Bearing Alloy, 605	7	Cu 61.00; Mn 2.50; Si 1.00; Pb 0.50; Zn 35.00	Rods—Screw machine products, hydraulic pump connecting rod retainers.
Brazing Brass, Western Brass 340	9	Cu 60.5; Pb 0.17; Zn balance	Low melting brazing sheets.
Medium-Leaded Forgeable Bearing Alloy	3, 7	Cu 60.00; Mn 2.50; Si 1.00; Pb 1.00; Zn 35.50	Forgings—Hydraulic transmission gears, hydraulic pump cylinder barrels, bearings. Heat treatable.
Leaded Forgeable Bearing—Alloy	3	Cu 60.00; Pb 0.75; Si 0.80; Mn 2.50; Zn 35.95	Rods and forgings. Gears and bushings.
Low-Leaded Manganese Bronze	3	Cu 58.50; Pb 0.60; Sn 1.00; Fe 1.00; Mn 0.35; Zn 38.55	Rods and forgings. Clutch discs, pump rods, shafting, valve stems and bodies.
Forgeable Bearing Alloy	3, 7, 15	Cu 58.00; Mn 2.50; Si 0.75; Al 1.50; Zn 37.25	Forgings, rods—Screw machine products, chain saw clutch bearings, squirrel cage feed fingers, hydraulic pump driving cams, lead screw nuts.
Architectural Bronze—R56.C	3	Cu 58.00; Al 0.15; Fe 0.15; Mn 0.15; Zn 41.55	An architectural bronze having a golden color. Welds well. Rod, shapes, and forgings.
Manganese Bronze—R-57	3	Cu 57.50; Al 3.00; Fe 2.00; Mn 3.0; Zn 34.50	Used for parts which are subjected to heavy loads. Rods and forgings.
Manganese Bronze—R-56	3	Cu 57; Al 1; Fe 1; Zn 41	Rods, shapes and forgings. High strength, high hardness manganese bronze. Valve stems and counter weights.
Nickel Silver, 12%	1, 9	Cu 56.50; Zn 31.50; Ni 12.00	Strip—Springs and instrument parts.
Tinicosil, 54 (Extruded Leaded Nickel Silver)	15	Cu 47.00; Ni 10.00; Pb 2.25; Mn 2.00; Zn 38.75	Round and hexagon rods—Screw machine products, instrument parts, fishing tackle, valve and plumbing parts.
Tinicosil, 53 (Extruded Nickel Silver)	15	Cu 46; Ni 10; Zn 44	Forgings—Plumbing, valves, instrument parts.
Leaded Nickel Silver, 10%	1	Cu 45; Zn 42; Ni 10; Pb 1; Mn 2	Rods, bars, extruded shapes, forgings—Screw machine products, instrument parts, ornamental architectural shapes.

KEY TO SOURCE:
(1) American Brass Co., Waterbury, Conn.
(2) Ampco Metal Inc., Milwaukee.
(3) Bohn Aluminum & Brass Corp., Detroit.
(4) Bridgeport Brass Co., Bridgeport, Conn.
(5) Bridgeport Rolling Mills Co., Stratford, Conn.
(6) Chase Brass & Copper Co. Inc., Waterbury, Conn.
(7) Mueller Brass Co., Port Huron, Mich.
(8) New England Brass Co., Taunton, Mass.
(9) Metals Div., Olin Mathieson Chemical Corp., East Alton, Ill.
(10) Phelps Dodge Copper Products Corp., New York.
(11) Plume & Atwood Mfg. Co., Thomaston, Conn.
(12) Revere Copper & Brass Inc., New York.
(13) Scoville Mfg. Co., Waterbury, Conn.
(14) Seymour Mfg. Co., Seymour, Ind.
(15) Titan Metal Mfg. Co., Bellefonte, Pa.
(16) Wolverine Tube Div., Allen Park, Mich., Calumet & Hecla Inc.
(17) Bristol Brass Corp., Bristol, Conn.

COPPER CASTING ALLOYS

Alloy and Nominal Composition %	Machinability*	Properties and Applications
ASTM specification B143-52		
1A—Tin bronze (Cu 88; Sn 10; Zn 2)	50	Bearings and bushings, fasteners, valve bodies for temperatures to 550° F, steam pressure castings, oil pumps, carburetors, gears.
1B—Tin bronze (Cu 88; Sn 8; Zn 4)	50	
2A—Leaded tin bronze (Cu 88; Sn 6; Pb 1.50; Zn 4.5)	60	
2B—Leaded tin bronze (Cu 87; Sn 8; Pb 1; Zn 4)	60	
ASTM specification B144-52		
3A—High-leaded, tin bronze (Cu 80; Sn 10; Pb 10; Ni 0.75 max)	80	Bearing bronzes. Acid resisting. Those with highest copper content for heaviest loads. Bearings, shoes, wedges, bushings and uses where an antifriction, soft material is needed.
3B—High-leaded, tin bronze (Cu 83; Sn 7; Pb 7; Zn 3; Ni 0.50 max)	70	
3C—High-leaded, tin bronze (Cu 85; Sn 5; Pb 9; Zn 1; Ni 0.50 max)	70	
3D—High-leaded, tin bronze (Cu 78; Sn 7; Pb 15; Ni 0.75 max)	80	
3E—High-leaded, tin bronze (Cu 70; Sn 5; Pb 25; Ni 0.75 max)	90	
ASTM specification B145-52		
4A—Leaded red brass (Cu 85; Sn 5; Pb 5; Zn 5)	90	General purpose, moderate strength castings. Superior machinability. Plumbing goods, pumps, hardware, ornamental objects, low pressure valves. Air, gas, oil, and water fittings.
4B—Leaded red brass (Cu 83; Sn 4; Pb 6; Zn 7)	90	
5A—Leaded semired brass (Cu 81; Sn 3; Pb 7; Zn 9)	90	
5B—Leaded semired brass (Cu 76; Sn 3; Pb 6; Zn 15)	90	

Alloy and Nominal Composition %	Machinability*	Properties and Applications
ASTM specification B146-52		
6A—Leaded yellow brass (Cu 72; Sn 1; Pb 3; Zn 24)	80	Same type uses as red brasses. More difficult to cast, but sometimes preferred for color. Ferrules, andirons, furniture hardware, ship trimming.
6B—Leaded yellow brass (Cu 67; Sn 1; Pb 3; Zn 29)	80	
6C—Leaded yellow brass (Cu 61; Sn 1; Pb 1; Zn 36.35; Al 0.15)	..	
ASTM specification B147-52		
7A—Leaded, high strength, yellow brass (Cu 61; Sn 0.75; Pb 0.75; Zn 35.5; Fe 1; Al 0.75; Mn 0.25)	60	Used where strength and toughness are required. Heavy duty valve stems, gears, cams, bearings, hydraulic cylinder parts, marine fittings, lever arms, pump bodies, gas engine bases, brackets, screwdown nuts, hydraulic cylinder parts.
8A—High strength yellow brass (Cu 58; Zn 39.25; Fe 1.25; Al 1.25; Mn 0.25)	30	
8B—High strength manganese bronze (Varies to meet requirements)	30	
8C—High strength manganese bronze (Varies to meet requirements)	20	
ASTM specification B148-52		
9A—Aluminum bronze (Cu 88; Fe 3; Al 9)	20	Strong, corrosion resistant alloys. Good high heat strength; 9B, C, and D are heat treatable. Gears, bushings, bearings, propellers, pickling baskets, valve seats, marine equipment, worms, heavy duty feed nuts.
9B—Aluminum bronze (Cu 89; Fe 1; Al 10)	35	
9C—Aluminum bronze (Cu 85; Fe 4; Al 11)	20	
9D—Aluminum bronze (Cu 81; Fe 4; Ni 4; Al 11)	20	
ASTM specification B149-52		
10A—Leaded nickel brass (Cu 57; Sn 2; Pb 9; Zn 20; Ni 12)	70	Sometimes called nickel silvers. Corrosion resistant hardware, plumbing fixtures, ornamental castings, dairy and soda fountain equipment, musical instruments, boat and railroad car fittings, trim.
11A—Leaded nickel bronze (Cu 64; Sn 4; Pb 4; Zn 8; Ni 20)	..	
11B—Leaded nickel bronze (Cu 66.5; Sn 5; Pb 1.5; Zn 2; Ni 25)	..	
ASTM specification B198-58		
12A—Silicon bronze (Sn 1 max; Pb 0.5 max; Zn 4 max; Fe 2.5 max; Mn 1.5 max; Al 1.5 max; Si 1-5; Cu rem)	..	Valve parts for corrosive conditions; good corrosion resistance in absence of oxygen. Naval parts, chemical parts, brackets, pole line hardware.
13A—Silicon brass (Pb 1 max; Zn 12-16; Si 2.5-4; Cu rem)	..	
13B—Silicon brass (Pb 0.5 max; Zn 12-16; Si 3-5; Cu rem)	..	
No ASTM specification		
Silicon-aluminum bronze (Cu 91; Al 7; Si 2)	50	Corrosion resistant. Higher strength than silicon brasses. Valves, radar parts, pressure castings. Heat treatable. Welding tips, nonsparking tools.
Silicon-aluminum bronze (Cu 90; Al 7; Si 3)	50	
Beryllium bronze (Cu 96.5; Ni 1.1; Be 2.2-2.8)	20-40	

*Basis: Free cutting brass=100.

ALUMINUM WROUGHT ALLOYS

Aluminum Assn. Designation	Chemical Composition % max or range. Al remainder	Commercial Forms	Properties and Applications
EC	Al 99.45 min	S,W,B,E,T,R	Electric conductors.
1060*	Si 0.25; Fe 0.35; Cu 0.05; Mn 0.03; Mg 0.03; Zn 0.05; Ti 0.03; Al 99.60 min; others 0.03 each	S,T	Chemical equipment and railroad tank cars.
1100*	Si & Fe 1.0; Cu 0.20; Mn 0.05; Zn 0.10; Al 99.00 min	S,W,B,E,T,F,R	Sheet metalwork, spun hollow ware, and decorative parts. Good formability. Impact extrusions.**
1130	Si & Fe 0.7; Cu 0.20; Al 99.30 min	S	Used primarily for reflector sheet in lighting fixtures.
1145	Si & Fe 0.55; Cu 0.05; Mn 0.05; Al 99.45 min; others 0.03 each	Foil	Used in making foil.
2011	Si 0.40; Fe 0.7; Cu 5.0-6.0; Zn 0.30; Pb 0.20-0.6; Bi 0.20-0.6	W,B,R	Screw machine products.
2014*	Si 0.50-1.2; Fe 1.0; Cu 3.9-5.0; Mn 0.40-1.2; Mg 0.20-0.8; Cr 0.10; Zn 0.25; Ti 0.15	S,B,E,T,F,R	Heavy duty structures, aircraft, and truck frames. High strength with good machinability.
Alclad 2014	(same as above)	S	Corrosion resistance is better than 2014.
2017	Si 0.8; Fe 1.0; Cu 3.5-4.5; Mn 0.40-1.0; Mg 0.20-0.8; Cr 0.10; Zn 0.25	W,B,R	Screw machine products. Higher strength than 2011.
2018	Si 0.9; Fe 1.0; Cu 3.5-4.5; Mn 0.20; Mg 0.45-0.9; Cr 0.10; Ni 1.7-2.3; Zn 0.25	F	Aircraft engine cylinder heads and pistons. High strength with good machinability.
2024	Si 0.50; Fe 0.50; Cu 3.8-4.9; Mn 0.30-0.9; Mg 1.2-1.8; Cr 0.10; Zn 0.25	S,W,B,E,T,R	Aircraft structures, truck wheels, screw machine products. High strength and hardness.
Alclad 2024	(same as above)	S	Same as 2024 with greater corrosion resistance.
2025	Si 0.50-1.2; Fe 1.0; Cu 3.9-5.0; Mn 0.40-1.2; Mg 0.05; Cr 0.10; Zn 0.25; Ti 0.15	F	Propeller blades and other high strength forgings.
2117	Si 0.8; Fe 1.0; Cu 2.2-3.0; Mn 0.20; Mg 0.20-0.50; Cr 0.10; Zn 0.25	W	Cold heading wire and rivets.
2218	Si 0.9; Fe 1.0; Cu 3.5-4.5; Mn 0.20; Mg 1.2-1.8; Cr 0.10; Ni 1.7-2.3; Zn 0.25	F	Aircraft engine cylinder heads and pistons, jet engine impellers and compressor rings.
3003*	Si 0.6; Fe 0.7; Cu 0.20; Mn 1.0-1.5; Zn 0.10	S,W,B,E,T,F,R	Cooking utensils, pressure vessels, tanks, piping, architectural uses, buildings' hardware, foil.
Alclad 3003	(same as above)	S,T	Tea kettles, chemical equipment, heat exchange tubes, pressure vessels, storage tanks, flashing.
3004*	Si 0.30; Fe 0.7; Cu 0.25; Mn 1.0-1.5; Mg 0.8-1.3; Zn 0.25	S	Special sheet metalwork, shoe eyelets, pressure vessels, storage tanks.
Alclad 3004	(same as above)	S	Industrial building sheets and flashing.
4032	Si 11.0-13.5; Fe 1.0; Cu 0.50-1.3; Mg 0.8-1.3; Cr 0.10; Ni 0.50-1.3; Zn 0.25	F	Pistons, forging stock.
4043*	Si 4.5-6.0; Fe 0.8; Cu 0.30; Mn 0.05; Mg 0.05; Zn 0.10; Ti 0.20	W	Intermediate strength welding wire. Cladding on brazing sheets.
5005	Si 0.40; Fe 0.7; Cu 0.20; Mn 0.20; Mg 0.50-1.1; Cr 0.10; Zn 0.25	S	Refrigerator uses, architectural and auto trim.
5050*	Si 0.40; Fe 0.7; Cu 0.20; Mn 0.10; Mg 1.0-1.8; Cr 0.10; Zn 0.25	S,W,B,T,R	Decorative refrigerator parts, builders' hardware, coiled tubes; architectural and auto trim.
Alclad 5050	(same as above)	S	Better corrosion resistance than 5050.
5052*	Si & Fe 0.45; Cu 0.10; Mn 0.10; Mg 2.2-2.8; Cr 0.15-0.35; Zn 0.10	S,W,B,T,R	Sheet metalwork; appliances; bus, truck, and marine uses. Workability and weldability good.
5056*	Si 0.30; Fe 0.40; Cu 0.10; Mn 0.05-0.20; Mg 4.5-5.6; Cr 0.05-0.20; Zn 0.10	W,R	High strength aluminum wire, rivets, staple wire, zippers.
Alclad 5056	(same as above)	W,R	Insect screen cloth.
5083	Si 0.40; Fe 0.40; Cu 0.10; Mn 0.30-1.0; Mg 4.0-4.9; Cr 0.05-0.25; Zn 0.25; Ti 0.15	S,W,B,E,R	High strength welded structures, tanks, marine uses.
5086	Si 0.40; Fe 0.50; Cu 0.10; Mn 0.20-0.7; Mg 3.5-4.5; Cr 0.05-0.25; Zn 0.25; Ti 0.15	S,W,B,E,R	Structural alloy with good weldability. Trailer tanks, unfired pressure vessels, towers, elevator cars and truck frames, marine applications.
5154*	Si & Fe 0.45; Cu 0.10; Mn 0.10; Mg 3.1-3.9; Cr 0.15-0.35; Zn 0.20; Ti 0.20	S,W,B,E,T,R	Pressure vessels, marine uses. High strength welding wire.
5254*	Si & Fe 0.45; Cu 0.05; Mn 0.01; Mg 3.1-3.9; Cr 0.15-0.35; Zn 0.20; Ti 0.05	S,W,B,T,R	High purity version of 5154. Special uses in the chemical industry.
5356*	Si & Fe 0.50; Cu 0.10; Mn 0.05-0.20; Mg 4.5-5.5; Cr 0.05-0.20; Zn 0.10; Ti 0.06-0.20	W	Welding wire.
5357	Si 0.12; Fe 0.17; Cu 0.07; Mn 0.15-0.45; Mg 0.8-1.2	S	Refrigerator parts, builders' hardware.

(Continued on Page S-26)

ALUMINUM WROUGHT ALLOYS (Continued)

Aluminum Assn. Designation	Chemical Composition % max or range. Al remainder	Commercial Forms	Properties and Applications
5454	Si & Fe 0.40; Cu 0.10; Mn 0.50-1.0; Mg 2.4-3.0; Cr 0.05-0.20; Zn 0.25; Ti 0.20	S,B,E,T,R	Strong welded structures which operate at slightly elevated temperatures. Tanks, tubes, pipes.
5456	Si & Fe 0.40; Cu 0.10; Mn 0.50-1.0; Mg 4.7-5.5; Cr 0.05-0.20; Zn 0.25; Ti 0.20	S,W,B,E,R	Uses same as 5083. Available as welding filler wire.
5457	Si 0.08; Fe 0.10; Cu 0.20; Mn 0.15-0.45; Mg 0.8-1.2; others 0.03 each, total 0.10	S	Used for trim on autos. Takes a bright anodized finish.
5652*	Si & Fe 0.40; Cu 0.04; Mn 0.01; Mg 2.2-2.8; Cr 0.15-0.35; Zn 0.10	S,W,B,T,R	High purity version of 5052. Special uses in chemical field; tanks for hydrogen peroxide.
6011	Si 0.6-1.2; Fe 1.0; Cu 0.40-0.9; Mn 0.8; Mg 0.6-1.2; Cr 0.30; Ni 0.20; Zn 1.5; Ti 0.20	S,R	Roll formed products such as lamp bases. Venetian blind stock.
6053	Si 45-65% of Mg; Fe 0.35; Cu 0.10; Mg 1.1-1.4; Cr 0.15-0.35; Zn 0.10	W,R	Rivet wire and rivets.
6061	Si 0.40-0.8; Fe 0.7; Cu 0.15-0.40; Mn 0.15; Mg 0.8-1.2; Cr 0.15-0.35; Zn 0.25; Ti 0.15	S,W,B,E,T,F,R	Heavy duty structures where corrosion resistance is needed. Bridge railings, marine uses, furniture.
Alclad 6061	(same as above)	S	Better corrosion resistance and appearance.
6062	Si 0.40-0.8; Fe 0.7; Cu 0.15-0.40; Mn 0.15; Mg 0.8-1.2; Cr 0.04-0.14; Zn 0.25; Ti 0.15	E,T	Alternate for 6061; preferred for extrusions and tubes.
6063	Si 0.20-0.6; Fe 0.35; Cu 0.10; Mn 0.10; Mg 0.45-0.9; Cr 0.10; Zn 0.10; Ti 0.10	E,T	Pipe, railings, builders' hardware, windows, architectural uses, truck and trailer flooring.
6066	Si 0.9-1.8; Fe 0.50; Cu 0.7-1.2; Mn 0.6-1.1; Mg 0.8-1.4; Cr 0.40; Zn 0.25; Ti 0.20	W,B,E,T,F,R	Trailer and aircraft structures. Strength and corrosion resistance between 6061 and 2024.
6101*	Si 0.30-0.7; Fe 0.50; Cu 0.10; Mn 0.03; Mg 0.35-0.8; Cr 0.03; Zn 0.10; B 0.06; others 0.03 each, total 0.10	W,B,E,T,R	High strength electric conductor.
6151	Si 0.6-1.2; Fe 1.0; Cu 0.35; Mn 0.20; Mg 0.45-0.8; Cr 0.15-0.35; Zn 0.25; Ti 0.15	F	Intricate forgings for machine and automotive parts.
6951	Si 0.20-0.50; Fe 0.8; Cu 0.15-0.40; Mn 0.10; Mg 0.40-0.8; Zn 0.20	S,W,B,E,T	Heat exchangers and cooling systems.
7001	Si 0.35; Fe 0.40; Cu 1.6-2.6; Mn 0.20; Mg 2.6-3.4; Cr 0.18-0.40; Zn 6.8-8.0; Ti 0.20	E,T,R,B	High strength alloy for aircraft structures.
7072	Si & Fe 0.7; Cu 0.10; Mn 0.10; Mg 0.10; Zn 0.8-1.3	W	Metallizing wire for sprayed, corrosion resistant coatings. Cladding alloy.
7075	Si 0.50; Fe 0.7; Cu 1.2-2.0; Mn 0.30; Mg 2.1-2.9; Cr 0.18-0.40; Zn 5.1-6.1; Ti 0.20	S,W,B,E,F,T,R	Aircraft structures and keys. High strength alloy.
Alclad 7075	(same as above)	S	Improved corrosion resistance over 7075.
7076	Si 0.40; Fe 0.6; Cu 0.30-1.0; Mn 0.30-0.8; Mg 1.2-2.0; Zn 7.0-8.0; Ti 0.20	F	Forgings, propeller blades.
7079	Si 0.30; Fe 0.40; Cu 0.40-0.8; Mn 0.10-0.30; Mg 2.9-3.7; Cr 0.10-0.25; Zn 3.8-4.8; Ti 0.10	E,F	Similar to 7075; preferred for heavy sections.
7178	Si 0.50; Fe 0.7; Cu 1.6-2.4; Mn 0.30; Mg 2.4-3.1; Cr 0.18-0.40; Zn 6.3-7.3; Ti 0.20	S,B,E,R	Very high strength structural alloy; aircraft applications.
Alclad 7178	(same as above)	S	Increased corrosion resistance over 7178.
7277	Si 0.50; Fe 0.7; Cu 0.8-1.7; Mg 1.7-2.3; Cr 0.18-0.35; Zn 3.7-4.3; Ti 0.10	Rivets and rivet rod	Large rivets that are hot driven. High strength applications.

NOTE: Other metals allowed for each alloy—each 0.05, total 0.15, except where noted.

*Be 0.0008 max for welding electrode and filler wire only.

Commercial forms: S—Sheets and plates. W—Wire. E—Extrusions. B—Bars. T—Tubes and pipe. F—Forgings and forging stock. R—Rods.

**Other alloys for impact extrusions: 2014, 6061, 6151.

ALUMINUM CASTING ALLOYS

Alloy	Composition Limits % max or range; Al remainder	Properties and Uses by Casting Type
12 (112 or 113) ASTM CS72A SAE 33; F 720	Cu 6.0-8.0; Fe 1.4; Si 1.0-4.0; Mn 0.6; Mg 0.10; Zn 2.5; Ti 0.25; Ni 0.35; others 0.50	Fair castability and good machinability. Early general purpose alloy. *Permanent Mold:* Vacuum cleaner housings, general purpose castings. *Sand:* Transmission housings, cover plates, manifolds, and miscellaneous machined castings.
13 ASTM S12B SAE 305 F 0120; A 2312; Ap 13	Cu 0.6; Fe 1.3; Si 11.0-13.0; Mn 0.35; Mg 0.10; Zn 0.35; Ni 0.50; Sn 0.15; others 0.25	Excellent castability with good corrosion resistance. Good mechanical properties. General purpose alloy for large intricate parts with thin sections. *Die:* Typewriter frames, outboard motor pistons, dental equipment, instrument cases.
Ap Z33	Cu 2.5-3.5; Si 4.5-5.5; Mg 0.10; Zn 2.5-3.5; Fe 1.0; Mn 0.50; others 0.50	Good machinability, fair castability. Takes high polish. Similar to Z50. *Sand:* Houshold appliances, automotive, and miscellaneous machined parts.
Ap Z39	Cu 3.5-4.5; Si 8.5-9.5; Mg 0.1; Zn 1.5-2.5; Fe 1.2; Mn 0.5; Ni 0.5; others 0.4 each	Good castability and excellent machinability. *Die:* Automatic transmission impellers and housings, toys, brackets, and other castings where machining is required.
43 ASTM S5C SAE 35, 304 F 050; A 2314; Ap 43	Cu 0.15; Fe 0.8; Si 4.5-6.0; Mn 0.35; Mg 0.05; Zn 0.35; Ti 0.25; others 0.05 each	Excellent castability and pressure tightness; good weldability and ductility, good corrosion resistance. *Permanent Mold:* Carburetor bodies, refrigerator shelf brackets and fittings, cooking utensils. *Sand:* Architectural and ornamental parts, pipe fittings, cooking utensils, food handling equipment, and marine fittings. *Die:* Cookware, marine fittings.
Ap Z50	Cu 4.0-5.0; Si 2.5-3.5; Mg 0.07; Zn 1.5-2.5; Fe 1.0; Mn 0.6; Ni 0.3	Good machinability, fair castability. Takes high polish. *Sand:* Household appliances, automotive, and miscellaneous machined parts.
108 ASTM CS43A Ap 50; F 430; A 2334	Cu 3.5-4.5; Fe 1.2; Si 2.5-3.5; Mn 0.50; Mg 0.10; Zn 1.0; Ti 0.25; Ni 0.35; others 0.50	General purpose alloy with fair castability. *Sand:* Manifolds, valve bodies, and similar castings.
A132 ASTM SN122A SAE 321 F 1121 Ni	Cu 0.50-1.5; Fe 1.3; Si 11.0-13.0; Mn 0.35; Mg 0.7-1.3; Zn 0.35; Ti 0.25; Ni 2.0-3.0; others 0.05	Good high temperature properties at 500 to 600° F. Low coefficient of thermal expansion. Weldability good. *Permanent Mold:* Pulleys, sheaves, automotive, and diesel pistons.
F132 ASTM SC103A SAE 332; Ap 34	Cu 2.0-4.0; Fe 1.2; Si 8.5-10.5; Mn 0.50; Mg 0.5-1.5; Zn 1.0; Ni 0.50; Ti 0.25; others 0.5	Similar to A132 but with better castability and machinability.
138 ASTM CS104A F 1040.3; Ap 38	Cu 9.0-11.0; Fe 1.5; Si 3.5-4.5; Mn 0.6; Mg 0.15-0.35; Zn 1.5; Ti 0.25; Ni 1.0; others 0.50	High as-cast hardness; good castability and good machinability. *Permanent Mold:* Sole plates for electric hand irons.
142 (Y-alloy) ASTM CN 42A SAE 39; A142; F 401.5 Ni; A Z142; Ap 59	Cu 3.5-4.5; Fe 1.0; Si 0.7; Mn 0.35; Mg 1.2-1.8; Zn 0.35; Cr 0.25; Ti 0.25; Ni 1.7-2.3; others 0.15	Good strength at elevated temperatures. *Permanent Mold:* Aircraft generator housings, diesel and aircraft pistons, air cooled cylinder heads. *Sand:* Diesel engine pistons and air cooled cylinder heads.

Alloy	Composition Limits % max or range; Al remainder	Properties and Uses by Casting Type
Ap Red X 8 ASTM SC 82A SAE 327	Cu 1.0-2.0; Si 7.0-8.5; Mg 0.2-0.6; Zn 1.0; Cr 0.3; Fe 1.0; Mn 0.2-0.6; others 0.2 each	Castability and mechanical properties good. Rugged, tough alloy for extreme applications. *Sand:* Cylinder blocks, crankcases, supercharger housings, and general automotive use.
Ap Red X 11 ASTM SC 122A	Cu 1.0-2.0; Si 10.5-11.8; Mg 0.4-1.0; Zn 1.0; Fe 0.9; Mn 0.5-0.9; others 0.2 each	Good castability with low coefficient of expansion. *Permanent Mold:* Automotive pistons and similar applications.
Ap Red X 20	Cu 1.0-2.0; Si 19-22; Mg 0.4-1.0; Mn 0.2-0.6; Ni 0.3-1.0; Fe 0.8; Zn 1.0	Excellent wear resistance, low coefficient of thermal expansion. *Sand, Permanent Mold,* and *Die:* Cylinders, liners, brakes, precision instruments.
152 Ap 66 ASTM CS66A SAE 300	Cu 5.5-7.5; Fe 1.5; Si 5.0-6.0; Mn 0.8; Mg 0.20-0.6; Zn 0.8; Ti 0.25; others 0.8	Good elevated temperature strength and good machinability. *Permanent Mold:* Automotive pistons.
195 ASTM C4A SAE 38; F 410; A 2315, 2335; Ap 52	Cu 4.0-5.0; Fe 1.0; Si 1.5; Mn 0.35; Mg 0.03; Zn 0.35; Ti 0.25; others 0.15	Castability fair with good machining properties. Good balance of mechanical properties for parts needing strength and ruggedness. *Sand:* Flywheel and rear axle housings, bus and aircraft wheels, spring hangers, fittings, crankcases; usually heat treated.
214 ASTM G4A SAE 320; F 004; Ap 414	Cu 0.15; Fe 0.50; Si 0.35; Mn 0.35; Mg 3.5-4.5; Zn 0.15; Ti 0.25; others 0.15	Castability poor; good balance of mechanical properties. Excellent corrosion and tarnish resistance. Good alloy for anodizing. *Sand:* Dairy and food handling equipment, cooking utensils, fittings for chemical and sewage use, hardware, and ornamental housings.
218 ASTM G8A F 008; Ap 418	Cu 0.25; Fe 1.8; Si 0.35; Mn 0.35; Mg 7.5-8.5; Zn 0.15; Ni 0.15; Sn 0.15; others 0.25	Good resistance to corrosion and tarnish. Excellent strength and ductility. Good for anodizing. *Die:* Parts requiring high strength, ductility and corrosion resistance, such as aircraft and marine fittings, conveyor units, hardware. Not best for intricate parts due to poor castability.
220 ASTM G10A SAE 324; F 0010; Ap 420	Cu 0.25; Fe 0.30; Si 0.25; Mn 0.15; Mg 9.5-10.6; Zn 0.15; Ti 0.25; others 0.15	Requires special foundry practice. Highest strength and elongation of any sand casting alloy when heat treated. Good machinability and corrosion resistance. *Sand:* Parts requiring strength and shock resistance; Aircraft fittings, levers, brackets. Not for use above 250° F.
319 ASTM SC64C SAE 329	Cu 3.0-4.5; Fe 1.2; Si 5.5-7.0; Mn 0.8; Mg 0.50; Zn 1.0; Ti 0.25; Ni 0.50; others 0.50	Excellent castability with good mechanical properties. *Sand:* Piano plates and frames, engine crankcases, oil pans, rear axle housings requiring leak tightness, general purpose uses.
A319 Ap Alloast 70 ASTM SC64D SAE 326 F 460; Al 2364	Cu 3.3-4.3; Fe 1.0; Si 5.5-7.0; Mn 0.50; Mg 0.10; Zn 1.0; Ti 0.25; Ni 0.35; others 0.50	Excellent castability, good mechanical properties. Pressure tightness good. *Sand:* Engine crankcases, oil pans, automatic transmission housings. *Permanent Mold:* Typewriter frames, engine parts.
333	Cu 3.0-4.5; Fe 1.2; Si 8.0-10.0; Mn 0.8; Mg 0.6; Zn 1.0; Ni 0.5; Ti 0.2; others 0.50	Excellent casting characteristics with good mechanical properties. *Permanent Mold:* General purpose castings, engine parts, gas meter housings and regulator parts.
355 (A-355) ASTM SC51A SAE 322 F 150.5; Ap 41; A 2351, 2355	Cu 1.0-1.5; Fe 0.6; Si 4.5-5.5; Mn 0.50; Mg 0.45-0.60; Zn 0.35; Cr 0.25; Ti 0.25; others 0.15	Castability and weldability good. Pressure tightness good. Parts usually heat treated. *Permanent Mold:* Aircraft supercharger covers, impellers, fittings, and timing gears. Meter parts and fuel pump bodies. *Sand:* Air compressor pistons, printing press bed plates, crankcases, water jackets, gear housings, electric motor fans and blowers. Widely used. A355 parts used at elevated temperatures.
356 ASTM SG70A SAE 323 Ap 46; A 2356, 2370; F 070.3	Cu 0.25; Fe 0.60; Si 6.5-7.5; Mn 0.35; Mg 0.20-0.40; Zn 0.35; Ti 0.25; others 0.15	Castability and weldability good. Good pressure tightness and resistance to corrosion. Parts usually heat treated. *Permanent Mold:* Machine tool parts, handwheels, aircraft pump parts. *Sand:* Automotive transmission cases, flywheel housings, oil pans, rear axle housings, brackets, fittings, and pump bodies.
357; A 2357	Cu 0.05; Si 7.0; Mg 0.5; Fe 0.15	High strength and good ductility after heat treatment. *Sand* and *Permanent Mold:* Highly stressed aircraft and missile structures, high velocity blowers and impellers.
364	Cu 0.20; Fe 1.5; Si 7.5-9.5; Mn 0.10; Mg 0.20-0.40; Zn 0.15; Ni 0.15; Cr 0.25-0.50; Be 0.02-0.04; others 0.15	Excellent castability and mechanical properties. *Die:* High ductility castings where resistance to impact is important.
Ap Ternalloy 5 ASTM ZG32A SAE 311	Cu 0.20; Si 0.20; Mg 1.4-1.8; Zn 2.7-3.3; Cr 0.20-0.40; Fe 0.8; Mn 0.4-0.6; Ti 0.25; others 0.05 each	High strength and good elongation without heat treatment. Exceptional dimensional stability. Good brazing and welding alloy. *Sand:* Pipe fittings, wrenches, farm machinery, machine tool equipment, high pressure valves, and other high strength uses. *Permanent Mold:* Street lighting equipment, heavy duty brackets, tooling equipment, precision gages, castings for electronics.
Ap Ternalloy 7 ASTM ZG42A SAE 312	Cu 0.20; Si 0.20; Mg 1.8-2.4; Zn 4.0-4.5; Fe 0.8; Mn 0.40-0.60; Cr 0.20-0.40; Ti 0.25; others 0.05 each	Same as above but for parts needing less elongation and higher yield strength. *Sand* and *Permanent Mold:* Can be heat treated to high strength.
360 ASTM SG100B SAE 309; F 090.5; Ap 36; A 2360	Cu 0.6; Fe 1.3; Si 9.0-10.0; Mn 0.35; Mg 0.40-0.60; Zn 0.50; Ni 0.50; Sn 0.15; others 0.25	Excellent castability. Mechanical properties and corrosion resistance good. *Die:* Aircraft, marine, and outboard motor parts, general purpose castings.
380 Ap 30; F 480; A 2393 SAE 306	Cu 3.0-4.0; Fe 1.3; Si 7.5-9.5; Mn 0.50; Mg 0 10; Zn 1.0; Ni 0.50; Sn 0.35; others 0.50	Castability and mechanical properties good. Good machinability. *Die:* General purpose parts. Most widely used diecasting alloy.
Ap Z39	Same as 380, but Zn 3.0	Good castability, excellent machinability. *Die:* General purpose, replacing 380.
384 ASTM SC114A Ap 39-11 SAE 303	Cu 3.0-4.5; Fe 1.3; Si 10.5-12.0; Mn 0.50; Mg 0.10; Zn 1.0	Excellent for thin walls. *Die:* Wringer frames, toys, automatic transmissions, general purpose thin wall castings.
Ap 417 Almag ASTM GM70B	Cu 0.10; Si 0.20; Mg 6.2-7.5; Fe 0.25; Mn 0.10-0.25; Ti 0.10-0.25; others 0.05 each	High strength, exceptional ductility; good anodizing characteristics and machinability. *Sand:* C-clamps, brackets and machined parts requiring strength, machinability, corrosion resistance, polishing, and anodizing. *Permanent Mold:* Impellers, optical equipment needing high polish or anodized finish.
A612 ASTM ZG61B SAE 313	Cu 0.35-0.65; Fe 0.50; Si 0.15; Mn 0.05; Mg 0.6-0.8; Zn 6.0-7.0; Ti 0.25; others 0.15	High strength and ductility without heat treatment. Good machinability. *Sand:* General purpose castings, particularly for brazing.
C612 ASTM ZC60A SAE 314	Cu 0.35-0.65; Fe 1.4; Si 0.35; Mn 0.05; Mg 0.25-0.45; Zn 6.0-7.0; Ti 0.25; others 0.15	High strength and ductility without heat treatment. Good machinability. *Permanent Mold:* Torque converter impeller blades and furniture parts requiring brazing.
F Tenzaloy ASTM ZC81A-B	Cu 0.40-1.0; Fe 1.0; Si 0.25; Mn 0.6; Mg 0.20-0.50; Zn 7.0-8.0; Cr 0.35; Ti 0.25; Ni 0.15; others 0.25	High strength without heat treatment. Ages at room temperature to give properties of heat treated castings. *Permanent Mold:* Machine tool frames, high speed fan rotors. *Sand:* Housings for hoists and other heavy duty equipment. Street signs and brackets. Excellent machinability, easily brazed.
40E ASTM ZG61A SAE 310	Cu 0.30; Fe 1.0; Si 0.25; Mn 0.30; Mg 0.50-0.65; Zn 5.2-6.0; Cr 0.40-0.60; Ti 0.10-0.25; others 0.25	Good mechanical properties without heat treatment. Good resistance to corrosion and shock. *Sand:* Aircraft and instrument parts subject to shock.
750 Ap 700	Cu 0.7-1.3; Fe 0.7; Mn 0.10; Si 0.7; Ni 0.7-1.3; Ti 0.20; Sn 5.5-7.0; others 0.30	Excellent bearing qualities with good compressive yield strength. *Permanent Mold* and *Sand:* Bearings, bushings, and parts needing bearing properties.
F Adaptaloy	Cu 2.0; Mn 1.0	Highly ductile alloy. Useful for castings that must be cold formed for assembly operation. Tensile, yield, and hardness are comparable to the 43 alloy.

Key to Producers' Trade Names: A—Aluminium Ltd. Sales Inc. Ap—Apex Smelting Co. F—Federated Metals Div., American Smelting & Refining Co.

ZINC DIECASTING ALLOYS

ASTM, SAE Number, and Commercial Name	Composition Limits % ASTM B86-57T Specification	Outstanding Properties	Typical Applications
AG40A SAE-903 Zamak-3	Cu 0.25 max; Al 3.5-4.3; Mg 0.03-0.08; Fe 0.100 max; Pb 0.007 max; Cd 0.005 Max; Sn 0.005 max	Retention of impact strength and dimensions. Used where stability is important.	Carburetors, fuel pumps, refrigerator hardware, washing machines, parking meters, television, any of below.
AC41A SAE-925 Zamak-5	Cu 0.75-1.25; Al 3.5-4.3; Mg 0.03-0.08; Fe 0.100 max; Pb 0.007 max; Cd 0.005 max; Sn 0.005 max	Greater hardness and tensile strength. Used where hardness is important.	Business machines, gears, cams, hardware, lawn mowers, fans, small tools, any of above.

ZIRCONIUM

Material	Nominal Composition %	Properties and Applications
Commercial Grade Grade 11 Grade 12	Zr plus Hf 99.5 (Hf 2)	Ductile and formable, weldable. Grade 11 has 64,000 psi tensile, grade 12 is 60,000 but withstands corrosion under more severe conditions. Used for chemical processing equipment, heat exchangers. Resists acids except hydrofluoric.
Reactor Grade Grade 21	Hf 200 ppm max	Low thermal neutron cross section for nuclear applications, in liquid metal cooled and fast breeder reactors. Flashbulb filler material, surgical implants.
Zircalloy 2 Grade 32	Sn 1.5; Cr 0.1; Fe 0.13; Ni 0.05	Resists corrosion by hot water and steam; small neutron cross section. Specifications: MIL-Z-19859A; ASTM B 350-60T, B 351-60T, B 352-60T, B 353-60T.
Zircalloy 4 Grade 34	Sn 1.5; Cr 0.10; Fe 0.13-0.24; Ni 0.007 max	Similar to Zircalloy 2, less hydrogen pickup.
Grade 41	Cu 0.5; Mo 0.5	70,000 psi tensile, resistant to wet and dry CO_2, good high temperature strength.
Grade 42	Cu 1.09; Mo 1.5	80,000 psi tensile, similar to Grade 41.

BERYLLIUM-BEARING ALLOYS

Producers' Designations Brush Beryllium Co.	Beryllium Corp.	Nominal Composition %	Properties and Applications
CASTING ALLOYS			
Master alloys			
Beryllium Copper	Beryllium Copper	Be 4.0; Cu bal	Used as a source of beryllium in compounding alloys.
Beryllium Aluminum	Beryllium Aluminum	Be 5.0; Mg 1.0 max; Al bal	
Beryllium Magnesium Aluminum		Be 5.0; Mg 0.50 max; Al bal	
	Beryllium Magnesium Aluminum	Be 5.0; Mg 3.0; Al bal	
Beryllium Nickel		Be 10.0-50.0 as spec.; Ni bal	
Copper base			
35 C		Be 0.25-0.50; Ni 1.40-1.60	High conductivity, heat treatable alloy for resistance welding dies and electrodes. Meet RWMA Class 3 specifications.
10 C	10–CR	Be 0.65; Co 2.50	High conductivity, heat treatable alloy with moderate strength and hardness. Maintains conductivity and hardness to 700° F. Circuit breaker and switch parts, resistance welding electrodes, butt-welding and projection welding dies. Meets RWMA Class 3 specifications.
20 C	20–CR	Be 2.15; Co 0.50	Heat treatable alloy with good fluidity, low pouring temperature, excellent wear and corrosion resistance, high strength. Bearings, gears, cams, valve and pump parts, drawing dies.
	50–CR	Be 0.50; Co 1.55; Ag 1.10	High conductivity alloy for resistance welding dies and electrodes. Good hardness and strength, low surface contact resistance, resists oxidation at elevated temperatures. Meets RWMA Class 3 specifications.
	70–CR	Be 0.15; Cr 0.90	Heat treatable, high conductivity, good fluidity. Class 2 alloy in resistance welding components.
240 C		Be 2.45; Ni 1.10	Heat treatable alloy which has the highest strength of copper-base alloys. Provides excellent mechanical properties with moderate conductivity.
275 C	275–CR	Be 2.75; Co 0.50	Heat treatable alloy with maximum hardness and wear resistance. Used in plastic molds, deep drawing dies.
Nickel base			
260 C		Be 2.55-2.80; C 0.40 max; Ni bal	Heat treatable alloys with excellent castability, extremely high strength and hardness, and good corrosion resistance. Used in turbine wheels, glass molds, plastic compression molds, valve bodies, and wrench jaws.
220 C		Be 2.00-2.30; C 0.40 max; Ni bal	
WROUGHT ALLOYS*			
Copper base			
25	25	Be 1.90; Co 0.25	In strip form, can be blanked, formed, deep drawn, or spun, then heat treated to provide maximum mechanical properties. They can be supplied in a mill hardened condition for limited forming operations. Uses include springs, diaphragms, bellows, electronic parts, bearings, gears, torsion bars, electrical connectors.
165	165	Be 1.70; Co 0.25	
	50	Be 0.40; Co 1.55; Ag 1.0	High conductivity alloy, good hardness and strength, resists oxidation at elevated temperatures. Bearings, gears, torsion bars, electrical connectors.
10	10	Be 0.50; Co 2.50	These alloys in the form of plates, bars, and forgings are used for welding dies, bus bars, plastic mold parts, and drawing dies.
35		Be 0.35; Ni 1.50	
	Beryldur	Be 1.0; Co 0.25; Others 4	A moderate strength alloy with the same uses as 25 and 165 alloys.

*All the Brush Beryllium Co. wrought alloys are supplied as billets, plates, bars, and strip including the trademarked Pennroid Precision Strip. Beryllium Corp. Alloy 165 and Beryldur are available in sheets and strip. Alloy 50 is supplied in rods, bars, and billets. Alloys 10 and 25 are available as billets, plates, sheets and strip, rods, and bars. Alloy 25 is also supplied in wire form. Beryldur is a trade name.

HIGH STRENGTH STEELS

Name	Producer	Chemical Composition Limits, Per Cent C	Mn	P	S	Si	Cu	Mo	Cr	Ni	Others	Yield Point Min psi	Tensile Strength Min psi	% Elongation in 2 in. for Stand. ASTM Spec.
Algo-Loy 1315	Algoma Steel Corp. Ltd.	0.10–0.20	1.10–1.65	0.045 max	0.050 max	0.15–0.35	0.40 max	.....	.....	.....	.....	50,000	70,000	22
Algo-Loy 1317	Algoma Steel Corp. Ltd.	0.25 max	1.65 max	0.045 max	0.050 max	0.35 max	0.20 min	0.05 max	0.30 max	0.30 max	.....	50,000	70,000	20
Cor-Ten	(2)	0.12 max	0.20–0.50	0.07–0.15	0.05 max	0.25–0.75	0.25–0.55	.....	0.30–1.25	0.65 max	.....	50,000	70,000	22
Clay-Loy	Colorado Fuel & Iron Corp.	0.22 max	1.25 max	0.05 max	0.05 max	0.35 max	0.50 max	.....	.....	.....	V 0.2 min	50,000	70,000	..
Dynalloy I	Alan Wood Steel Co.	0.15 max	0.60–1.00	0.05–0.10	0.05 max	0.30 max	0.30–0.60	0.05–0.15	.....	0.35–0.70	.....	50,000	70,000	22
Dynalloy II	Alan Wood Steel Co.	0.15 max	0.60–1.00	0.05–0.10	0.05 max	0.30 max	0.30–0.60	0.05–0.15	.....	0.35–0.70	.....	45,000	62,000	25
GLX-45-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	45,000	65,000	22
GLX-50-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	50,000	70,000	22
GLX-55-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	55,000	75,000	22
GLX-60-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	60,000	80,000	22
Hi-Steel	Inland Steel Co.	0.12 max	0.50–1.00	0.12 max	0.05 max	0.15 max	0.55–1.30	0.18 max	.....	0.30–0.75	.....	50,000	70,000	22 (1)
Hi-Man	Inland Steel Co.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Hi-Man 440 (ASTM A-440)	Inland Steel Co.	0.28 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	.. ..	.....	..
High Strength #1	Armco Steel Corp.	0.15 max	0.40–0.95	0.04–0.07	0.04 max	0.15 max	0.50–0.75	.....	.....	0.60–0.90	.....	50,000	70,000	22
High Strength #2	Armco Steel Corp.	0.15 max	0.40–0.95	0.04–0.07	0.04 max	0.15 max	0.50–0.75	.....	.....	0.60–0.90	.....	45,000 typ.	64,000 typ.	..
High Strength #3	Armco Steel Corp.	0.10 max	0.30–0.90	0.04 max	0.05 max	0.10 max	0.20 max	.....	.....	.....	V 0.02 min	40,000 typ.	60,000	35 typ.
High Strength #4	Armco Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.15–0.35	0.20 min	.....	.....	.....	.....	50,000	70,000	22
High Strength #5	Armco Steel Corp.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	45,000	60,000	25
Jalten #1	Jones & Laughlin Steel Corp.	0.15 max	1.30 max	0.04 max	0.05 max	0.10 max	0.30 min	.....	.....	.....	V-0.035–0.065	50,000	70,000	22
Jalten #2	Jones & Laughlin Steel Corp.	0.15 max	1.40 max	0.14 max	0.05 max	0.10 max	0.30 min	.....	.....	.....	.....	50,000	70,000	22
Jalten #3	Jones & Laughlin Steel Corp.	0.25 max	1.35–1.65	0.04 max	0.05 max	0.15–0.30	0.20 min	.....	.....	.....	.....	50,000	70,000	22
Jalten #3R	Jones & Laughlin Steel Corp.	0.25 max	1.35–1.65	0.04 max	0.05 max	0.030 max	0.20 min	.....	.....	.....	.....	50,000	70,000	22
JLX-45-W	Jones & Laughlin Steel Corp.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01–0.04	45,000	65,000	22
JLX-50-W	Jones & Laughlin Steel Corp.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01–0.04	50,000	70,000	22
JLX-55-W	Jones & Laughlin Steel Corp.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01–0.04	55,000	75,000	22
JLX-60-W	Jones & Laughlin Steel Corp.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01–0.04	60,000	80,000	22
Jalloy-S-90	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.04 max	0.05 max	0.15–0.30	.....	0.20–0.30	.....	.....	.....	90,000	105,000	18 (4)
Jalloy-S-100	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.04 max	0.05 max	0.15–0.30	.....	0.20–0.30	.....	.....	Cb-0.01–0.04	100,000	115,000	18 (4)
Jalloy-S-110	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.04 max	0.05 max	0.15–0.30	.....	0.20–0.30	.....	.....	Cb-0.01–0.04	110,000	125,000	18 (4)
Jalloy 360	Jones & Laughlin Steel Corp.	0.25–0.31	1.35–1.65	0.04 max	0.05 max	0.15–0.30	0.20 min	0.10–0.20	.....	.....	.....	.....	.....	BHN-340-380 (4)
Jalloy 400	Jones & Laughlin Steel Corp.	0.25–0.31	1.35–1.65	0.04 max	0.05 max	0.15–0.30	0.20 min	0.10–0.20	.....	.....	.....	.....	.....	BHN-400-min (4)
Kaisaloy #1	Kaiser Steel Corp.	0.20 max	1.25 max	0.05 max	0.05 max	0.60 max	0.35 max	0.15 max	0.25 max	0.60 max	V 0.02 min Ti 0.005 min Al 0.25 max	50,000	70,000	23
Kaisaloy #2	Kaiser Steel Corp.	0.12 max	0.60 max	0.04 max	0.04 max	0.50 max	0.30 max	0.10 max	0.25 max	0.60 max	V 0.02 min Ti 0.005 min	45,000	60,000	25
Kaisaloy #3	Kaiser Steel Corp.	0.30 max	1.50 max	0.04 max	0.05 max	0.35 max	0.35 max	0.10 max	0.25 max	0.40 max	V 0.05 min Ti 0.005 min	.....	.....	..
Kaiser Structural High Strength Steel	Kaiser Steel Corp.	0.27 max	1.60 max	0.045 max	0.05 max	0.30 max	0.20 max	.....	.....	.....	.....	50,000	75,000	18
Man-Ten	United States Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Man-Ten (A440)*	United States Steel Corp.	0.28 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	..
Maxeloy	Crucible Steel Co. of America	0.15 max	1.20 max	0.07 max	0.04 max	0.50 max	0.20 min	.....	.....	0.50 max	.....	50,000	70,000	22
Mayari R	Bethlehem Steel Co.	0.12 max	0.50–1.00	0.12 max	0.05 max	0.20–0.90	0.50 max	.....	0.40–1.00	1.00 max	Zr 0.10 max	50,000	70,000	22
Medium Manganese	Bethlehem Steel Co.	0.25 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20–0.35	.....	.....	.....	.....	50,000	75,000	20
Manganese Vanadium	Bethlehem Steel Co.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
N-A-X High Tensile	Great Lakes Steel Corp., Weirton Steel Co., Republic Steel Corp., Sharon Steel Corp., Granite City Steel Co. (2)	0.15 max	0.50–1.00	0.04 max	0.05 max	0.60–0.90	0.25 max	0.20 max	0.40–0.70	.....	Zr 0.05–0.15	50,000	70,000	22
N-A-X Finegrain (3)	Great Lakes Steel Corp., Weirton Steel Co.	0.18 max	0.50–1.00	0.04 max	0.05 max	0.50–0.90	0.25 max	.....	.....	.....	Zr 0.05–0.15	50,000	70,000	22

(Continued on Page S-30)

HIGH STRENGTH STEELS (continued)

Name	Producer	Chemical Composition Limits, Per Cent C	Mn	P	S	Si	Cu	Mo	Cr	Ni	Others	Yield Point Min psi	Tensile Strength Min psi	% Elongation in 2 in. for Stand. ASTM Spec.
N-A-X High Manganese	Great Lakes Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	22
N-A-Xtra 80	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	80,000	95,000	18 (4)
N-A-Xtra 90	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	90,000	105,000	18 (4)
N-A-Xtra 100	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	100,000	115,000	18 (4)
N-A-Xtra 110	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	110,000	125,000	18 (4)
XAR-Abrasion Resistant (5)	Great Lakes Steel Corp.	0.10–0.30	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	165,000	180,000	16 (4)
Par-Ten	United States Steel Corp.	0.12 max	0.75 max	0.03 max	0.04 max	0.10 max	.....	.....	.....	.....	V 0.01–0.07	45,000 typ.	62,000 typ.	28 typ.
Republic "50"	Republic Steel Corp.	0.15 max	0.50–1.00	0.04 max	0.05 max	.....	0.30–1.00	0.10 min	0.30 max	0.40–1.10	.....	50,000	70,000	22
Republic "M"	Republic Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Republic "65"	Republic Steel Corp.	0.15 max	1.00 max	0.04 max	0.04 max	0.15 max	0.90–1.40	0.20–0.30	.....	1.00–1.50	.....	65,000	85,000	20 (4)
Republic "70"	Republic Steel Corp.	0.20 max	1.00 max	0.04 max	0.04 max	0.15 max	1.00–1.50	0.20–0.30	.....	1.20–1.75	.....	70,000	90,000	18 (4)
Steelcoley "S"	Steel Co. of Canada Ltd.	0.12	1.10	0.02	0.03	0.20	0.60	.....	0.50	0.75	.....	50,000	70,000	22
Steelcoley "G"	Steel Co. of Canada Ltd.	0.10	0.60	0.08	0.03	0.35	0.50	.....	0.50	0.55	.....	50,000	70,000	22
Stremlite	Steel Co. of Canada Ltd.	0.27 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	22
Tri-Steel	Inland Steel Co.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
Tri-Ten	United States Steel Corp.	0.22 max	1.25 max	0.040 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
"T-1"	United States Steel Corp., Lukens Steel Co.	0.10–0.20	0.60–1.00	0.040 max	0.050 max	0.15–0.35	0.15–0.50	0.45–0.60	0.40–0.80	0.70–1.00	V 0.03–0.10 B 0.002–0.006	100,000	115,000	18 (4)
U.S.S. Cu-Ni-Mo	United States Steel Corp.	0.21 max	0.80–1.10	0.04 max	0.05 max	0.15–0.30	0.50–0.80	0.20–0.30	.....	1.20–1.50	.....	65,000	140,000	18 (4)
Yoloy	Youngstown Sheet & Tube	0.15 max	0.75 max	0.10 max	0.05 max	0.30 max	0.75–1.25	.....	.....	1.50–1.85	.....	50,000	70,000	22 (1)
Yoloy A242	Youngstown Sheet & Tube	0.22 max	1.25 max	0.05 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
Yoloy B	Youngstown Sheet & Tube	0.12 max	0.75 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	V 0.01–0.07	45,000 typ.	62,000 typ.	28 typ.
Yoloy B HSX	Youngstown Sheet & Tube	0.18 max	1.00 max	0.09 max	0.05 max	0.30 max	0.20–0.50	.....	0.20–0.60	0.40–1.00	.....	45,000	80,000 max	25 typ.
Yoloy E HS	Youngstown Sheet & Tube	0.18 max	1.00 max	0.10 max	0.05 max	0.30 max	0.20–0.50	0.40 max	0.20–0.60	0.40–1.00	.....	50,000	70,000	22
Yoloy M Grade A	Youngstown Sheet & Tube	0.25 max	1.60 max	0.05 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	20
Yoloy M Grade B	Youngstown Sheet & Tube	0.23 max	1.40 max	0.05 max	0.05 max	0.15–0.30	0.20 min	.....	.....	.....	.....	45,000	70,000	22
Yoloy S	Youngstown Sheet & Tube	0.12 max	0.60 max	0.04 max	0.05 max	0.30 max	0.75–1.25	.....	.....	1.65–2.00	.....	65,000	95,000	20 (1, 4)
Yoloy 45W	Youngstown Sheet & Tube	0.10–0.25	0.30–1.00	0.05 max	0.05 max	.....	.....	.....	.....	.....	Cb added	45,000	.....	..
Yoloy 50W	Youngstown Sheet & Tube	0.10–0.25	0.30–1.00	0.05 max	0.05 max	.....	.....	.....	.....	.....	Cb added	50,000	.....	..
Ex-Ten-50	United States Steel Corp.	0.25 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01 min	50,000	.....	..
Ex-Ten-45	United States Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb-0.01 min	50,000	.....	..

(1) Steels with copper over a minimum of 0.60 will respond to precipitation hardening, resulting in a higher strength level, depending on time-temperature cycle performed.
(2) Domestic Producers: United States Steel Corp., Acme Steel Co., Algoma Steel Corp., Crucible Steel Co. of America, Greer Steel Co., Inland Steel Co., Lukens Steel Co., Republic Steel Corp. and Sharon Steel Corp.
(3) All licensees for N-A-X High Tensile are also licensed to produce N-A-X Finegrain.
(4) Heat treatment required to meet tensile properties shown.
(5) XAR Abrasion Resistant Steel is normally supplied to a Brinell hardness range of 363 to 406.

PROPERTIES AND TYPICAL APPLICATIONS: Strength of the high strength, low alloy steels as measured by their yield point is about 50 per cent higher than structural carbon steel. Yield points of the alloy and high strength grades are even higher. Working stress in tension can be more than 50 per cent greater. Besides higher yield strengths, they have good corrosion, abrasion, and fatigue resistance and can be fabricated by usual methods. Some applications: Tanks, trailers, trucks, material handling equipment, auto frames, wheels and bumpers, railroad cars, pole line hardware, earth moving equipment, mine cars, agricultural equipment, bridges, buckets, LPG cylinders, screens, towers, booms, cranes, dipper sticks, locomotive parts, mobile lifting equipment, portable military bridges, canal locks, gates and dams, lampposts, auto jacks, cable reels, stokers, furnace bodies, cabinets, and re-usable shipping containers.

SUPERSTRENGTH STEELS

Material	Nominal Composition %	Tensile Strength—psi
SAE 4130	C 0.30; Mn 0.50; Si 1.30; Cr 0.95; Mo 0.20	200,000 to 240,000
SAE 4330 modified with Vanadium (AMS 6427)	C 0.30; Mn 0.90; Si 0.30; Ni 1.80; Cr 0.85; Mo 0.45; V 0.05-0.10	220,000 to 240,000
AMS 6428	C 0.35; Mn 0.70; Si 0.30; Ni 1.80; Cr 0.80; Mo 0.35	220,000 to 240,000
SAE 4335 V (AMS 6434)	C 0.35; Mn 0.70; Si 0.30; Cr 0.85; Ni 1.85; Mo 0.35; V 0.20	210,000 to 260,000
SAE 4340 (AMS 6415)	C 0.40; Mn 0.65; Si 0.30; Cr 0.80; Ni 1.80; Mo 0.25	260,000 to 280,000
Timken 4741	C 0.36-0.44; Mn 0.60-0.90; P 0.040 max; S 0.040 max; Si 0.40-0.60; Cr 0.75-1.10; Ni 0.70-1.00; Mo 0.30-0.40	300,000 max
300-M Ultrahigh Strength Steel	C 0.40; Mn 0.75; Si 1.60; Ni 1.85; Cr 0.85; Mo 0.40; V 0.08	280,000 to 300,000
U. S. Steel Air Steel X-200	C 0.43; Mn 0.85; Si 1.50; Cr 2.00; Mo 0.50; V 0.05	280,000 min
U. S. Steel USS Strux (Mod. 98BV40)	C 0.35-0.40; Mn 0.85; Si 0.70; Ni 0.80; Cr 0.75; Mo 0.50; V 0.06; B 0.0015	260,000 to 280,000

SAE 4360	C 0.60 version of 4340	280,000 to 300,000
SAE 8630	C 0.20; Mn 0.80; Si 0.30; Cr 0.50; Ni 0.55; Mo 0.20	Carburized for increased strength.
SAE 8740	C 0.40; Mn 0.90; Si 0.30; Cr 0.50; Ni 0.55; Mo 0.25	210,000 to 260,000
SAE 9310	C 0.10; Mn 0.55; Si 0.30; Cr 1.25; Ni 3.25; Mo 0.12	Carburized for increased strength.
Crucible HY-Tuf (ASM 6418)	C 0.25; Mn 1.30; Si 1.50; Ni 1.80; Mo 0.40	230,000
Crucible UHS-260	C 0.35; Mn 1.25; Si 1.85; Cr 1.25; V 0.20; Mo 0.35	260,000 min
D6C	C 0.46; Mn 0.75; Si 0.25; Cr 1.05; Ni 0.55; Mo 1.00	220,000 to 280,000
Firth Sterling Astro-1	C 0.37; Cr 5.25; Mo 1.30; Si 1.00; V 0.50	220,000 to 290,000
Timken H.S. 220 (AMS 6407)	C 0.30; Mn 0.70; Si 0.60; Ni 2.05; Cr 1.20; Mo 0.45	220,000 to 240,000
Timken H.S. 260	C 0.40; Mn 0.70; Si 0.60; Cr 1.20; Ni 2.05; Mo 0.45	260,000 to 280,000
U. S. Steel USS Strux (Mod. 98BV40) AMS 6423	C 0.40-0.45 version of above	280,000 to 300,000
5CrMoV Aircraft Steel (1) (Modified H-11) VascoJet 1000; Crucible 218; Potomac A; Dynaflex; Unimach I	C 0.40; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	220,000 to 300,000
Unimach II	C 0.50; Mn 0.40; Si 1.00; Cr 5.00; Ni 1.50; Mo 1.40; V 1.00	220,000 to 310,000
Unimach UCX2	C 0.39; Mn 0.70; Si 1.0; Cr 1.10; Mo 0.25; V 0.15; Co 1.0	310,000

APPLICATIONS: In their appropriate tensile strength ranges, these steels are designed to provide the maximum usable strength where minimum weight is of primary importance. Such uses are in aircraft landing gear and air frame components, wing pylon parts and fasteners, wing attachment fittings, and superstrength bolts. Other applications: Sheet or plate parts for supersonic speeds, pressure vessels for aircraft use, oil well perforating guns and carbide bit bodies. Examples of other constructional parts are axles, gears, and shafting of all types. Although the acceptance of many of these superstrength steels will be a gradual process, today's trend toward machines and equipment operating at higher and higher stress levels will increase their ultimate use in many ways.

(1) Other tool steels, such as the S-1 and S-5 types, have high strengths, in the 300,000 psi range. Physical property data can be obtained from the producers.

TITANIUM

Material (nominal composition)	Specifications: AMS	Specifications: Military	Specifications: ASTM	Producers' Designations	Mill Forms	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	R.A. (%)	Properties and Applications
Unalloyed				Ti-35A	S,B,E,W,T	35,000	25,000	25	35	Special soft grade for uses where structural strength is less important than corrosion resistance. Heat exchangers.
Unalloyed	4902		B-265-58T B-348-59T B-338-58T B-337-58T	RM-30 Ti-45A	S,B,E,W,T	45,000	35,000	22	35	Valves heat exchangers, dished heads, and similar uses where corrosion resistance is an important design consideration.
Unalloyed	4902 4941 4951	Mil-T-9047B	B-265-58T B-348-59T B-338-58T B-337-58T	RM-40 RS-40 A-40 Ti-55A	S,B,E,W,T	65,000	50,000	28	50	Nonstructural aircraft and corrosion uses where ductility and formability are needed. Fusion weldable. Processing equipment, fittings, heat exchangers, valve trim, marine uses.
Unalloyed	4900A	Mil-T-9046C Mil-T-9047B	B-265-58T B-348-59T B-338-58T B-337-58T	RM-55 RS-55 A-55 Ti-65A	S,B,E,W,T	80,000	65,000	25	50	Properties and uses same as above except it has higher strength. Used as rods and wire for welding other titanium alloys; anodizing racks.
Unalloyed	4901B 4921B	Mil-T-9047B Mil-T-9046C	B-265-58T B-338-58T B-337-58T	RM-70 RS-70 A-70 Ti-75A	S,B,E,W,T	90,000	80,000	20	40	Used for same purposes as above grades, but where higher strengths are needed with some sacrifice in ductility and formability. Aircraft nacelles, webs, stiffeners, angles, shrouds, fire walls, fasteners, engine rings, ammunition boxes, gun blast panels, shroud spacers, anodizing racks.
Unalloyed	4921B	Mil-T-9047B	B-348-59T	Ti-100A	B	80,000	70,000	15	30	Properties and uses same as above.
ALPHA TITANIUM ALLOYS										
5Al-2.5Sn	4910 49-AB 4926 4966 4963	Mil-T-9046B Mil-T-9047B	B-265-58T B-348-59T	RM-5Al-2.5Sn RS-110C A-110AT Ti-5Al-2.5Sn	S,B,W,F	125,000	115,000	18	40	Forgings and welded sheet assemblies where creep resistance up to 900° F is required. Aircraft engine compressor case housings, tail cones, shroud spacers, stiffeners, high strength fusion welded assemblies.
8Al-1Mo-1V				Ti-8Al-1Mo-1V	S,B	147,000	135,000	16		High temperature jet engine forging alloy. Useful for airframes where creep properties of other alloys are not good enough at elevated temperatures. Extends temperature range about 150° F over alloys like 6Al-4V.

(Continued on Page 5-32)

TITANIUM (continued)

Material (nominal composition)	Specifications: AMS	Specifications: Military	Specifications: ASTM	Producers' Designations	Mill Forms	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	R.A. (%)	Properties and Applications
8Al-2Cb-1Ta				RM-821	S,B,E,W,F	135,000	125,000	15	40	Compressor blades, fire walls, tail cones, stiffeners, welded assemblies. High strength forgings. Has exceptional high temperature strength—about 200° F advantage in the 400 to 1000° F range.
ALPHA-BETA TITANIUM ALLOYS										
3Al-2.5V				RM-3Al-2.5V	S,E,T	100,000	85,000	15		Highly weldable; particularly suitable for fabricating into welded and seamless tubing. May be hardened after forming to ultimate strength of 120,000 to 130,000 psi.
3Al-5Cr	4927	Mil-T-9047B		RM-3Al-5Cr	B,F	145,000	135,000	13	35	Aircraft forgings; fasteners.
2Fe-2Cr-2Mo	4923	Mil-T-9047B		Ti-140A	S,B,F	130,000	115,000	15	25	Airframes, skins.
8Mn	4908A	Mil-T-9046C	B-265-58T	RM-8Mn RS-110A C-110M	S	130,000	120,000	15		For medium, high strength, sheet uses where good formability is needed. Not used for fusion welded assemblies or above 650° F. Longerons, bulkheads, channels, stressed skins, and frames.
4Al-4Mn	4925A	Mil-T-9047B		RM-4Al-4Mn RS-130 C-130AM	B,W,F	145,000	133,000	15	40	High strength airframe and engine forgings and fasteners where good weld ductility is not needed. Industrial equipment requiring maximum strength with good corrosion and erosion resistance.
4Al-3Mo-1V*				RM-431 RS-115 C-115AMoV Ti-4Al-3Mo-1V	S	133,000	123,000	11		Heat treatable sheets with good formability in solution condition. To get 155,000 psi yield strength, heat treat at 1650° F, water quench, and age at 925° F for 12 hours.
5Al-2.75Cr-1.25Fe*				RS-140	B,S	158,000	147,000	16	40	High strength forgings and sheet parts. Heat treatment increases tensile strength to 180,000 psi with corresponding increase in yield strength.
5Al-1.5Fe-1.4Cr 1.2Mo*	4929 4969	Mil-T-9047B		Ti-155A	B	145,000	135,000	10	20	Heat treatable forging stock for aircraft parts. Heat treatment gives average yield strength of 173,000, tensile strength of 180,000 psi. Heat treat capability guaranteed to 170,000 psi.
6Al-4V*	4928 4911	Mil-T-9046C Mil-T-9047B	B-265-58T	RM-6Al-4V RS-120A C-120AV Ti-6Al-4V	S,B,E,W,F	145,000†	130,000	13	40	Medium high strength aircraft and engine forgings. Ordnance equipment where good elevated temperature strength and stability are needed with good machinability. Compressor wheels and blades, spacers.
7Al-4Mo*				RM-7Al-4Mo RS-135 C-135AMo Ti-7Al-4Mo	B,E,T	145,000	135,000	10	20	Heat treatable forging alloy combines good creep resistance, stress stability, and high temperature strength. Used in aircraft turbines for compressor wheels and blades, hub-shafts, and spacer rings.
2.5Al-16V*				RM-2.5Al-16V	B,S,W	175,000**	160,000	6		Airframe skins, webs, angles, and shrouds, fasteners. Age hardened parts have good short time hot strength (yield strength about 100,000 psi up to 800° F). Sheets are heat treatable with good formability in solution treated condition.
BETA TITANIUM ALLOYS										
13V-11Cr-3Al*				RS-120B B-120VCA Ti-13V-11Cr-3Al	S,B,W	125,000	120,000	10		Weldable, heat treatable alloy for solid propellent pressure casings. Cold rolled and aged sheet provides tensile strengths in excess of 210,000 psi.

*Indicates response to heat treatment. (Guaranteed heat treat capabilities of alloys responding to heat treatment available from producers.)

**Age hardened. ***Vacuum annealed. †Sheets from Reactive Metals Inc., 180,000.

S—Sheets, strip, plates. E—Extrusions. T—Tubes.

B—Bars and billets. F—Forgings. W—Wire.

Producers' designations:

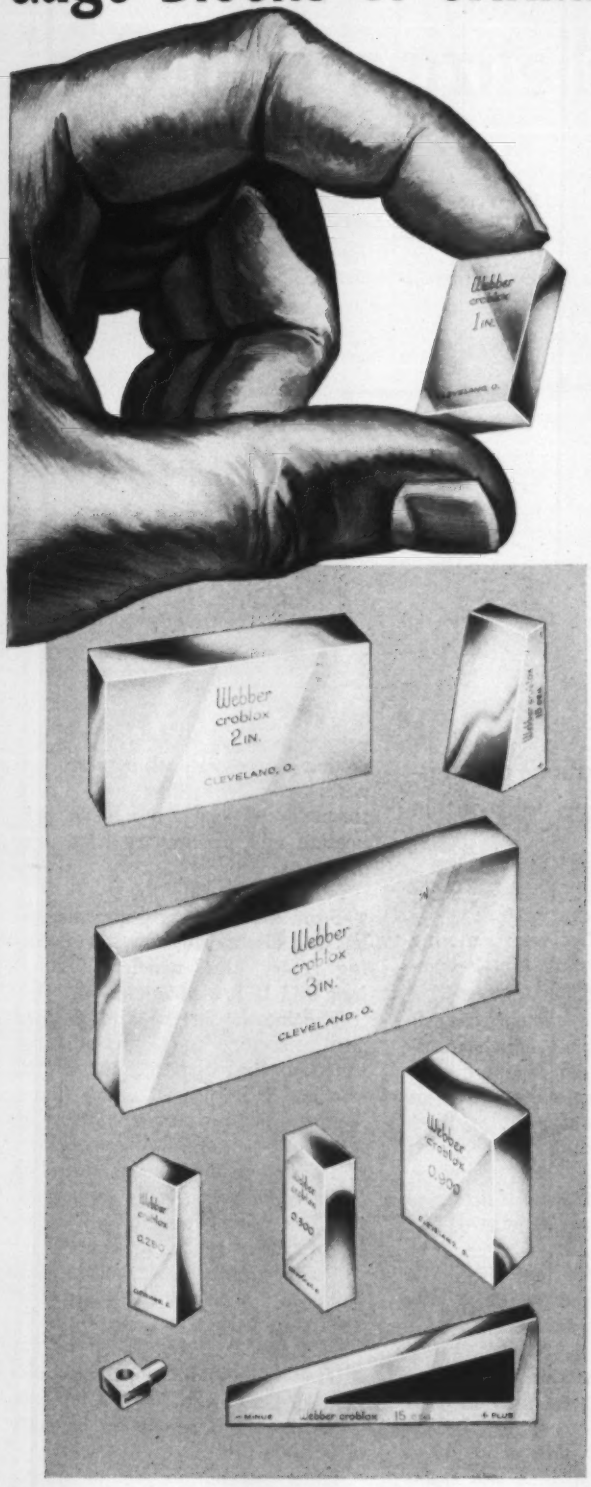
RM—Reactive Metals Inc., Niles, Ohio.

RS—Republic Steel Corp., Massillon, Ohio.

A, B, and C—Crucible Steel Co. of America, Midland, Pa.

Ti—Titanium Metals Corp. of America, New York.

Gage Blocks of CARMET Chromium Carbide



for new standards of dimensional control!

For enduring, ultra micro-accurate surface finishes and dimensional stability, CARMET Chromium Carbide represents the ultimate gage block material.

Harder by nature than steel . . . next to a diamond in hardness, yet far tougher . . . Chromium Carbide Gage Blocks withstand rougher use, eliminate costly dimensional errors, and cut frequency of calibration and replacement. They have a thermal coefficient of expansion similar to steel. Fingerprints are not harmful.

Lightweight, non-oxidizing, possessing superior "wringability" and a stable, fine grain structure that takes and holds a mirror-smooth gaging surface . . . CARMET Chromium Carbide in gage blocks is leading the way to rigid new standards of dimensional control.

Carmet doesn't make gage blocks, but furnishes the chrome carbide to the progressive manufacturers who do.

A precise blend of extremely hard, finely divided carbides of chromium with a nickel binder, CARMET Chromium Carbide assures predictable, consistent behavior and unmatched uniformity from piece to piece.

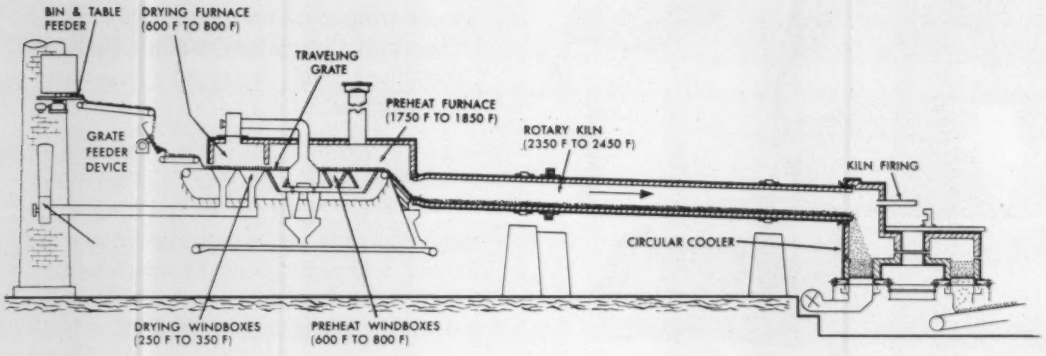
These same unique characteristics make CARMET Chromium Carbide an important material for extrusion dies, valve seats, sealing rings, chemical processing equipment . . . or any other application where resistance to oxidation, corrosion, abrasion, erosion or chemical attack may be involved. For more information, contact your local Allegheny Ludlum CARMET representative, or write: ***Allegheny Ludlum Steel Corporation, Carmet Division, Ferndale, Detroit 20, Michigan.***

1726

CARMET®

CEMENTED CARBIDE · DIVISION OF ALLEGHENY LUDLUM

New System Is Pelletizing Iron Ore


BIN & TABLE FEEDER
DRYING FURNACE (600 F TO 800 F)
TRAVELING GRATE
PREHEAT FURNACE (1750 F TO 1850 F)
ROTARY KILN (2350 F TO 2450 F)
GRATE FEEDER DEVICE
KILN FIRING
CIRCULAR COOLER
DRYING WINDBOXES (250 F TO 350 F)
PREHEAT WINDBOXES (600 F TO 800 F)

Material flow in the Allis-Chalmers Grate-Kiln system is from left to right

Cleveland-Cliffs Iron Co. makes first installation of Allis-Chalmers Grate-Kiln at its Humboldt mine and will put in the process at its Republic mine

LESS than a month ago, the first commercial installation of Allis-Chalmers Mfg. Co.'s Grate-Kiln system of agglomerating and pelletizing iron ore concentrate went into operation. A-C now has an order for an additional installation from the same buyer—Cleveland-Cliffs Iron Co.

The first installation was at the Humboldt Mining Co. plant, near Ishpeming, Mich. The plant is owned 50-50 by Cleveland-Cliffs and Ford Motor Co. Cleveland-Cliffs operates it.

• Equipment on order is for Marquette Iron Mining Co.'s Republic (Mich.) mine. Cleveland-Cliffs is majority owner and operator of the Republic facilities.

The system utilizes the advantages of the traveling grate and rotary kiln by combining the two methods. The traveling grate has been conventional equipment in iron ore pelletizing and sintering plants, and the rotary kiln is common in plants that make cement.

The Grate-Kiln system consists of: 1. A feed circuit which transforms finely ground iron ore concentrate into green balls (not heat treated) the size of marbles. 2. A chain type traveling grate which serves as a dryer and preheater. 3. A rotary kiln which fires the balls into finished pellets. 4. An annular cooler which recovers heat from the pellets for use within the system and brings the pellets down to a safe handling temperature.

• In the drying section of the traveling grate, the green balls are subjected to a downdraft of gases heated to about 600° F. This action dries the pellets and utilizes the moist pellet bed as a collector of dust from the process gases.

After passing under a dividing baffle, the pellets enter the preheat section where high temperature exit gases from the kiln are drawn through the bed to achieve preheating and preliminary hardening of pellets.

• From the traveling grate, the pellets are discharged into the revolving rotary kiln, which is 120 ft long and 10 ft in diameter.

The interior of the kiln is lined with refractory brick. Fuel oil is injected at the discharge end of the kiln and is burned in a long flame. Temperature in the kiln is 2450° F.

The product and the temperatures of the system are closely controlled to maintain consistently high quality. The system has enabled Cleveland-Cliffs to realize its aim of getting an extremely hard and durable pellet that will not break or powder off in storing or handling.

• The Humboldt plant has two parallel Grate-Kiln lines. They provide an annual pelletizing capacity of 650,000 tons.

Until installation of the system and an enlargement of concentrating facilities, the Humboldt plant had an annual capacity of 325,000 tons of concentrates but no pelletiz-

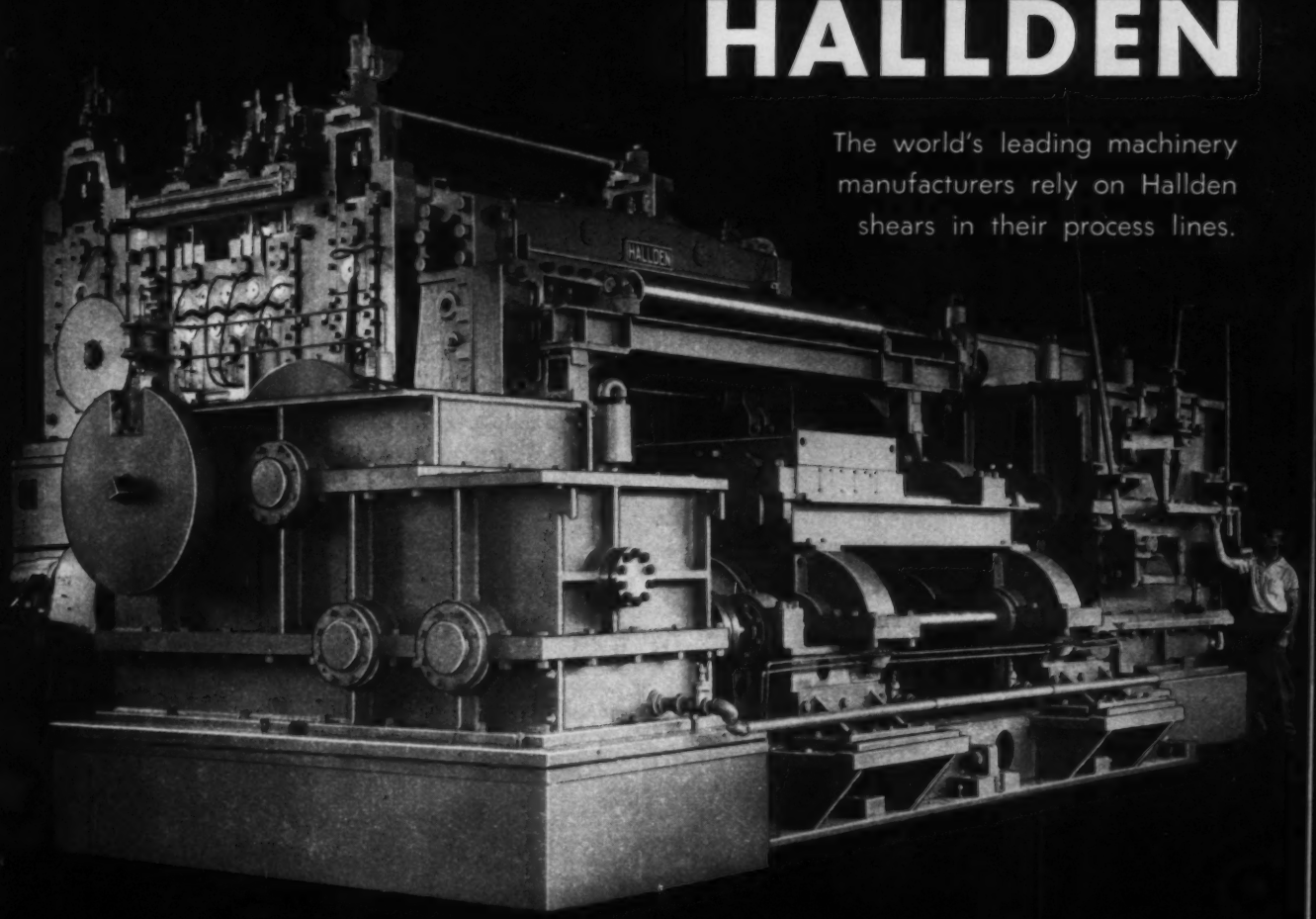
550,000 POUNDS OF PRECISION

The Guillotine Shear's superior cut on heavy gauges, synchronized on the fly

Another Hallden First — type 76 Guillotine Flying Shear, the world's largest, for continuous strip shearing — up to 5/8" thick, 100" wide aluminum — at ***two cuts per second.*** This new Hallden installation can cut mild steel up to 3/8" thick and 90" wide, with cut lengths infinitely variable up to 48 feet. Change of cut length and synchronization may be made while the Shear is in operation. For every high-production shearing application consult the shearing specialists.

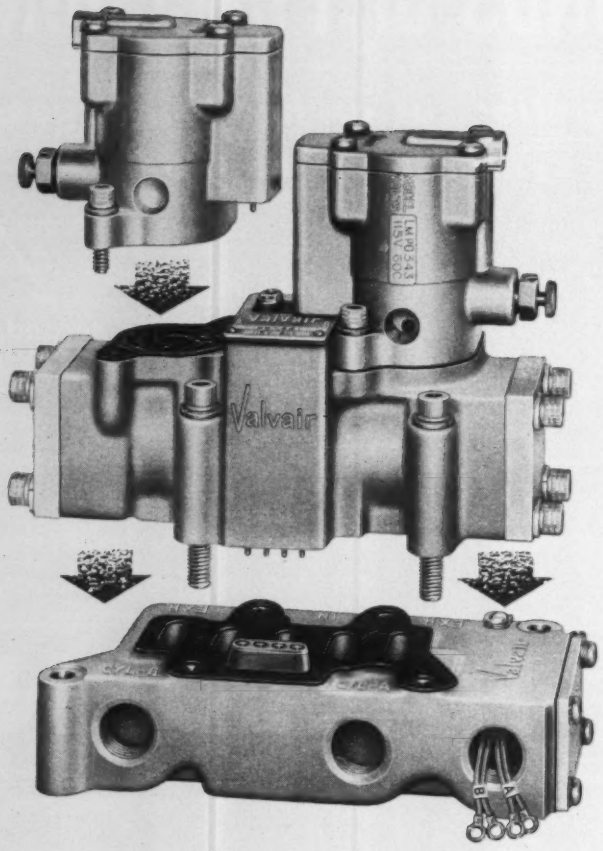
HALLDEN

The world's leading machinery manufacturers rely on Hallden shears in their process lines.



THE HALLDEN MACHINE COMPANY • THOMASTON, CONNECTICUT

Associates: The W. H. A. Robertson & Co., Ltd., Bedford, England



VALVAIR® ½" NPT PLUG-IN VALVES

MODEL PD-441 shown. 4-way single or double pilot-operated types, for sub-base or manifold mounting. Aluminum and stainless steel components assure multi-million cycle dependability. Interchangeable pilots, with coils guaranteed against burn-out for life of valve, fit any plug-in Speed King. Coils for ac or dc, any voltage . . . 35 — 200 psi range . . . integral junction box . . . optional manual over-ride, common or separate exhaust ports, sub-base connected external pilot supply . . . ¾ in. exhaust ports, ½ or ¾ in. inlet and cylinder ports . . . valve meets JIC standards.

Based on the service-proved design principle of the Speed King ¼ in. plug-in Valvair's ½ - ¾ in. plug-in valve series provides plug-in convenience and versatility to a wider range of control valve applications.

Electrical and pneumatic circuits are completed automatically when valve and pilot are plugged in . . . bolted down. The result — cost-cutting reduction of original installation and maintenance time. All power connections are made permanently in sub-base or manifold . . . there's no need to disturb piping or wiring for quick in-service maintenance.

What's more, advanced design shortens stroke . . . speeds response. Separate coded (4-wire) circuits on double solenoid models meet JIC requirements. Flow area through valve and sub-base equals that of full ½ in. pipe.

Whether your control valve applications are on the drawing board or now in service, it'll pay you to investigate the advantages of Valvair plug-in design. A call to your near-by Valvair field office will bring prompt application engineering recommendations.

For more information, write for Bulletin SPL. Address Dept. ST-1060, Bellows-Valvair, Akron 9, Ohio

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8098-3

ing facilities. Iron ore concentrate was shipped as powder to steel plants for sintering.

The Humboldt plant now represents an investment of $15 million, or about $23 per ton of annual capacity.

• Cleveland-Cliffs and Ford expect that the Humboldt plant will be enlarged.

The goal: Capacity of 6 million to 7 million tons of pellets annually in about eight years.

The Republic (Mich.) plant will boost its annual concentrate capacity from 700,000 annual tons to 1.6 million. Half of the product will average 64.5 per cent iron content and will be processed into pellets through the new facilities. The rest will be 62 per cent iron in content and will be pelletized by the Eagle Mills (Mich.) pelletizing plant, which has been serving the Republic mine.

The 64.5 per cent iron product will be obtained through regrinding and refloating of the concentrate in the newly constructed facilities.

• Completion of the Republic plant expansion will give Cleveland-Cliffs and its partners a total annual capacity of 2¼ million tons of iron ore pellets by early 1962.

Pellets from both the Humboldt and Republic plants come from the processing of jasper rock of 33 per cent iron content. The pellets make a high grade feed for blast furnaces and increase pig iron output.

In processing the jasper, Cleveland-Cliffs uses a flotation process to separate the iron particles from the noniron material. The magnetic process of separation used on magnetic ores will not work with the jasper of the Humboldt and Republic mines.

It is nonmagnetic.

Flotation involves the preferential coating of a particular mineral with a nonwettable oil film so that, upon coming in contact with an air bubble in a water-ore mixture. the coated particle will become attached to the bubble and rise to the surface of the mixture, where the iron particle can be captured.

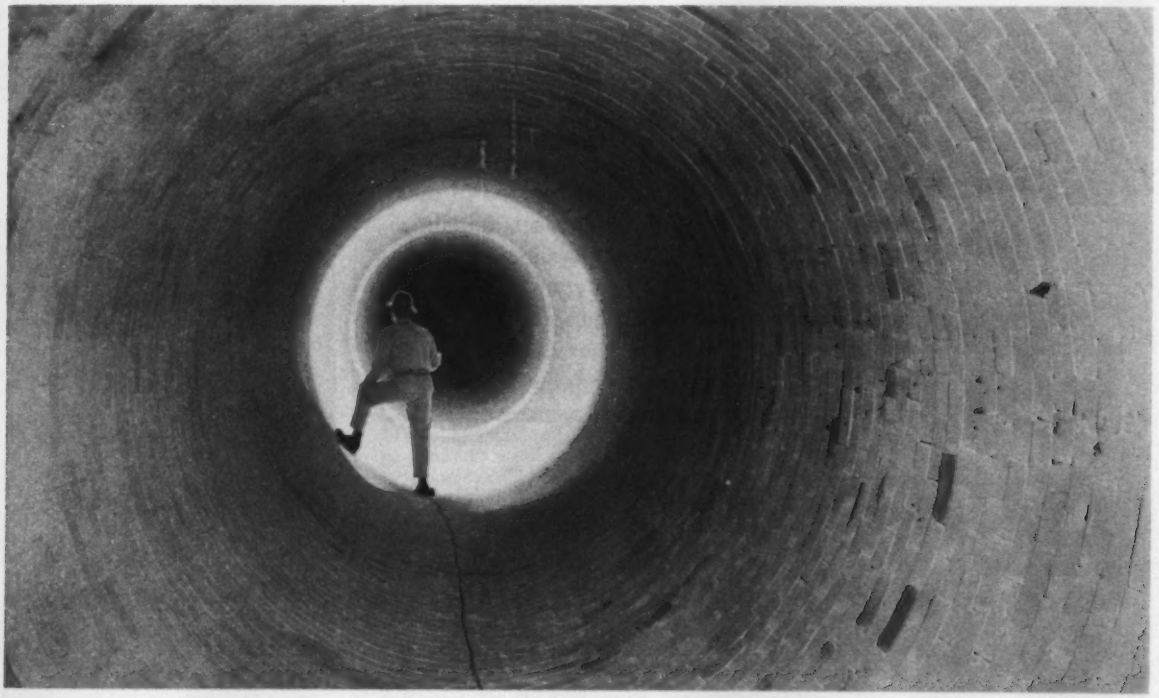
• Allis-Chalmers says its Grate-Kiln system is being investigated as a normal step in preparing all ore.

The system had its beginning about 35 years ago as a cement production method. Dr. O. G. Lellep, a German inventor, developed the process which involved the use of otherwise wasted, hot exhaust gases from kilns.

It was introduced to the U. S. through an exclusive arrangement between Dr. Lellep and Allis-Chalmers. A pilot plant was built at A-C's Milwaukee plant for further study. In 1958, Allis-Chalmers built a new pilot plant 1/50 the size of a commercial system to obtain information for full scale operation.

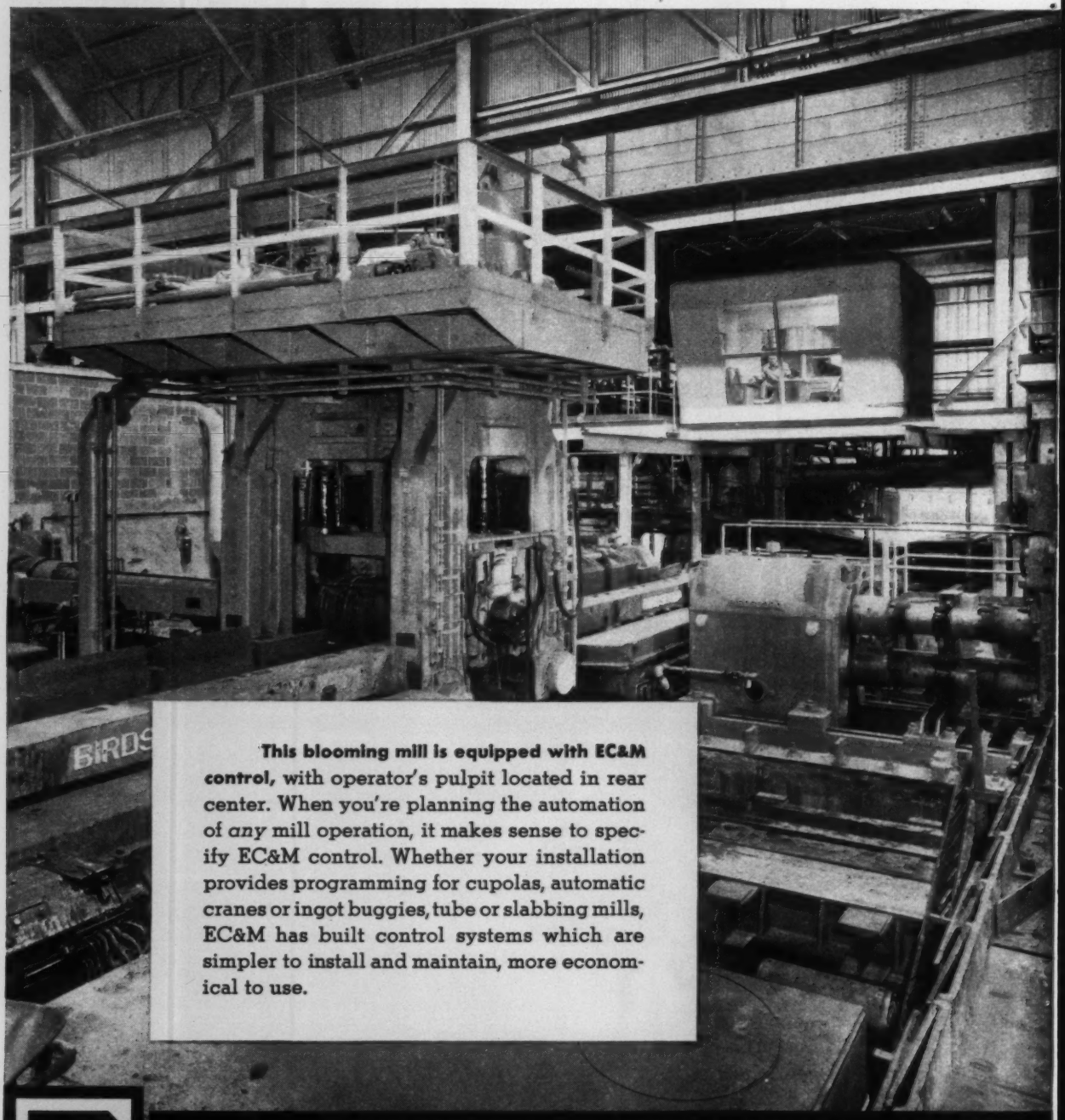
• Tests proved the commercial feasibility of the system for iron ore pelletizing and paved the way for the first installation at the Humboldt plant.

Arthur G. McKee & Co., Cleveland, contractor for engineering and construction of the Humboldt pelletizing plant, is also contractor for construction of the pelletizing facilities at the Republic mine. M. W. Kellogg Co., New York, will construct and enlarge the Republic mine's ore crushing and concentrattrate in the newly constructed facilities.



The 10 ft diameter of the rotary kiln dwarfs the inspector. Lengthwise, the kiln is 120 ft

Complete Mill Automation is Simpler,



This blooming mill is equipped with EC&M control, with operator's pulpit located in rear center. When you're planning the automation of *any* mill operation, it makes sense to specify EC&M control. Whether your installation provides programming for cupolas, automatic cranes or ingot buggies, tube or slabbing mills, EC&M has built control systems which are simpler to install and maintain, more economical to use.

SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

Less Expensive with EC&M Control

Minimum set-up time saves many man-hours of work. Each EC&M system is thoroughly engineered, tested and adjusted at the factory.

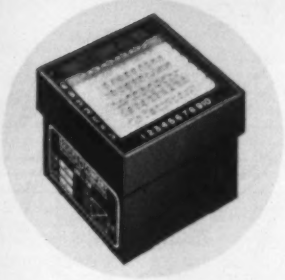
Accuracy and reliability make your production job easier and more profitable. Heavy-duty mill-type components are used throughout. In addition, Square D's new Norpak static control is widely used in EC&M systems for virtually maintenance-free operation.

Simple operation means that new operators can be trained quickly. For instance, EC&M automatic screwdown systems are equipped with easy-to-use push button controls, and programming is available by either punched cards or slider panels. Direct reading eliminates coding and de-coding, and there are no schedules to memorize.

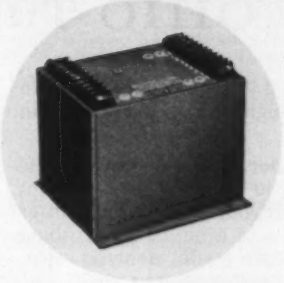
Systems for any job are built to fit your exact requirements, including new reactor control for stepless hoist installations. EC&M engineers are trained mill specialists who design, build and install the automatic control system that's best for *your* job.

Write for detailed information or contact your local Square D field office for details on EC&M automated mill control systems. Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio.

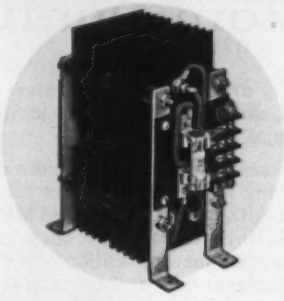
QUALITY COMPONENTS MAKE EC&M SYSTEMS DEPENDABLE



NORPAK,
Square D's new static control, adds extra reliability to EC&M systems. Transistorized NOR units are compact and sealed in Epoxy to keep out foreign matter and moisture. All external connections are positively made by locked-in tapered pin construction.



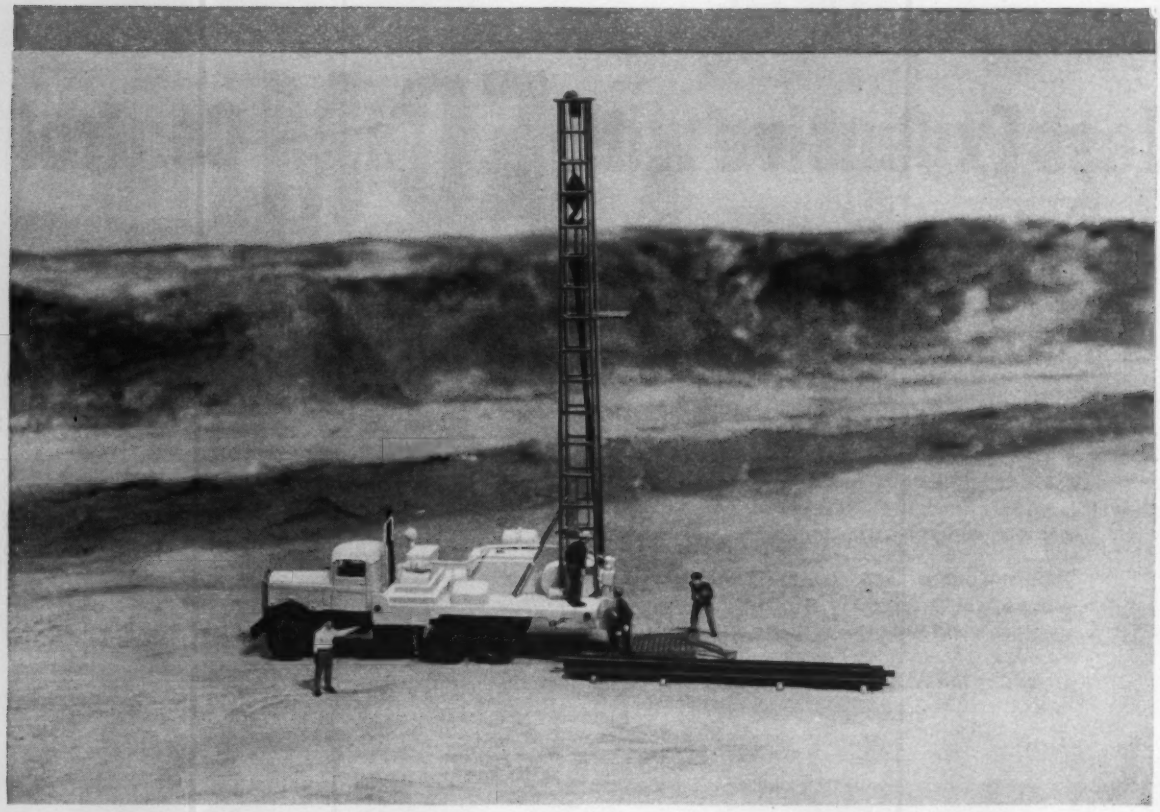
MAGNETIC AMPLIFIER
is frequently used in place of conventional thyratron and rotating amplifiers. Its rugged construction makes maintenance almost non-existent. Unlike tube-type amplifiers, magnetic amplifiers are not harmed by vibration, will give top performance indefinitely.



SILICON-CONTROLLED RECTIFIER
combines extremely high gain with very fast response. Like the grid in a thyratron tube, a silicon-controlled rectifier passes current only when a signal is applied. As used in EC&M systems, they provide a high-power output directly to a load.

wherever electricity is distributed and controlled

4530



Down-to-earth reasons for using Custom Quality OHIO Tubing

As in rotary drilling, which uses steel tubing internally upset by Ohio Seamless, greater strength and lighter weight may be important in your product.

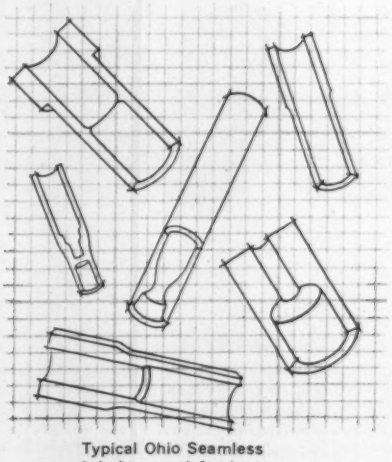
So before selecting a tubing source consider these important facts. OHIO Tubing is always the exact tubing you need for your product because OHIO Tubing is CUSTOM MADE for your product. Your order is manufactured to your own specifications to produce steel tubing especially for your application — the precise grade, analysis, size, shape, special anneal and tolerances best suited to your needs.

Ohio Seamless Tube produces both seamless and electric welded steel tubing — is prepared to form many finished or semi-finished tubular parts to your designs.

To get the most from your next steel tubing order, use Custom Made OHIO Tubing. Contact your nearest Ohio Seamless representative, or send part drawings to the plant at Shelby, Ohio — Birthplace of the Seamless Steel Tube Industry in America.

A-3061A

Model illustrated built to 3.5 mm scale.



Typical Ohio Seamless tubular upset forgings

OHIO SEAMLESS TUBE

Division of Copperweld Steel Company • **SHELBY, OHIO**

Seamless and Electric Resistance Welded Steel Tubing • Fabricating and Forging

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CANADA: Railway & Power Engr. Corp., Ltd. • EXPORT: Copperweld Steel International Company, 225 Broadway, New York 7, New York

42nd National Metal Congress and Exposition

PROGRAM

PHILADELPHIA

AMERICAN SOCIETY FOR METALS

Seminar

The Trade and Convention Center, Philadelphia, will house the 1960 Metal Show exhibits. Exhibit hours will be:

MONDAY, OCT. 17
12 noon to 6 p.m.
TUESDAY, OCT. 18
12 noon to 10 p.m.
WEDNESDAY, OCT. 19
12 noon to 10 p.m.
THURSDAY, OCT. 20
10 a.m. to 6 p.m.
FRIDAY, OCT. 21
10 a.m. to 6 p.m.

STRENGTHENING MECHANISMS IN SOLIDS

Bellevue-Stratford Hotel

SATURDAY, OCT. 15

9 A.M.

Introductory Review of Strengthening Mechanisms—W. R. Hibbard Jr., General Electric Research Laboratory.

Solid Solution Strengthening—P. A. Flinn, Westinghouse Research Laboratory.

Strengthening by Work Hardening — J. Washburn, University of California.

2 P.M.

Strengthening Mechanisms as Observed Directly by Electron Transmission Microscopy—J. Nutting, University of Cambridge, England.

Radiation Hardening—G. H. Vineyard, Brookhaven National Laboratory.

Point Defect Hardening—D. K. Wilsdorf, R. Maddin, and D. G. F. Wilsdorf, University of Pennsylvania.

SUNDAY, OCT. 16

9 A.M.

Strengthening by Martensitic Transformations—V. F. Zackay, Ford Scientific Laboratory.

Strengthening by Precipitation Reactions—W. D. Robertson, Yale University.

Fine Particle Strengthening—R. W. Guard, General Electric Research Laboratory.

2 P.M.

Hardening Effects Produced with Shock Waves—G. E. Dieter, Du Pont Engineering Research Laboratory.

Strengthening Mechanisms in Ionic and Inorganic Solids—T. L. Johnston, C. H. Li, and R. Stokes, Minneapolis-Honeywell Research Center.

Role of Surface Effects in Strengthening Mechanisms—E. Machlin, Columbia University.

Transaction Sessions

Bellevue-Stratford Hotel

MONDAY, OCT. 17

9 A.M.

PHYSICAL METALLURGY I

The Relationship Between the Constitution and Mechanical Properties of Titanium-Rich Alloys of Titanium and Cobalt—F. W. Yakymyshyn, G. R. Purdy, and J. Gordon Parr, University of Alberta; R. Taggart, University of Washington.

Self-Diffusion in Nickel Single Crystals—A. Messner, R. Benson, and J. E. Dorn, University of California.

Solubility of Oxygen in Delta Iron—E. S. Tankins and N. A. Gokcen, University of Pennsylvania.

Diffusion of Carbon in Thorium—D. T. Peterson, Iowa State University. Yield Point and Order-Hardening Phenomena in Some Commercial Nickel.

Silver Alloys—Victor A. Phillips and R. B. Jones, General Electric Co.

2 P.M.

PHYSICAL METALLURGY II

Grey and White Solidification of Cast Iron—M. Hillert, Swedish Institute for Metal Research.

Factors Controlling the Occurrence of Laves Phases and AB_2 Compounds Among Transition Elements—Austin E. Dwight, Argonne National Laboratory.

Laves-Type Phases of Hafnium—Rodney P. Elliott, Armour Research Foundation.

ASM PROGRAM

MONDAY, OCT. 17
2 P.M.

Effect of Rolling Procedure on the Kinetics of Recrystallization of Cold Rolled Iron—J. T. Michalak, U. S. Steel Corp.; and W. R. Hibbard Jr., General Electric Co.

Growth Processes in Recrystallization of Aluminum—S. Weissmann, Rutgers University.

TUESDAY, OCT. 18
9 A.M.

PHASE DIAGRAMS

The Ternary System Cadmium-Bismuth-Indium—E. A. Peretti, University of Notre Dame.

The Systems Y-Fe, Y-Ni, and Y-Cu—R. F. Domagala, J. J. Rausch, and D. W. Levinson, Armour Research Foundation.

Phase Equilibria and Properties of Yttrium-Titanium Alloys—D. W. Bare and O. N. Carlson, Iowa State College.

Columbium-Carbon System—R. P. Elliott, Armour Research Foundation.

Phase Relations in the Magnesium-Rich Region of the Mg-Al-Zn Phase Diagram—J. B. Clark, Dow Metal Products Co.

Heats of Formation of Iron-Manganese Alloys—W. B. Kendall and Ralph Hultgren, University of California.

9 A.M.

STEEL I

The Decomposition of Austenite in 4340 Steel During Cooling—E. P. Klier, Catholic University of America; and T. H. Yeh, International Business Machines Corp.

The Tensile Properties of Type 410 Stainless Steel Deformed Before and After Martensite Transformation—Yuzo Hosoi, National Research Institute, Japan; and K. E. Pinnow, Pennsylvania State University.

The Effect of Aluminum on Strain Aging and Internal Friction in Low Carbon Steel—F. H. Laxar, D. J. Blickwede, and J. W. Frame, Bethlehem Steel Co.

The Microstructure of Low-Carbon 3.25 Per Cent Silicon Steel—W. C. Leslie and R. L. Rickett, U. S. Steel Corp., and C. P. Stroble, Allegheny Ludlum Steel Corp.

On the Morphology of Proeutectoid Cementite—R. W. Heckel and H. W. Paxton, Carnegie Institute of Technology.

Low Temperature Flow and Fracture Tension Properties of Heat Treated SAE 4340 Steel—Frank R. Larson and John Nunes, Watertown Arsenal Laboratories.

2 P.M.

STEEL II

The Effect of Microstructure on Fatigue Strength and Structure of Steel—P. Shahinian and M. R. Achter, U. S. Naval Research Laboratory; and W. A. Pennington, University of Maryland.

The Effect of Phosphorus on the Elevated Temperature Strength and Weldability of Some Low Carbon Austenitic Stainless Steels—G. R. Rundell, Crucible Steel Co. of America; and R. J. Raudebaugh, International Nickel Co.

Size, Manganese Content, and Curie Point of Carbides Extracted from Manganese Steel—R. W. Gurry, Union Steel Corp.; J. Christakos, Esso Research Laboratories; and L. S. Darken, U. S. Steel Corp.

2 P.M.

PLASTIC DEFORMATION

Yield Point Phenomena in a Number of Commercial Copper Alloys and One Nickel Base Alloy—R. B. Jones and V. A. Phillips, General Electric Co.

Dynamic Stress-Strain Phenomena and Plastic Wave Propagation in Metals—R. Papirno and G. Gerard, New York University.

Precipitation of Phosphorus From Alpha Iron and Its Effect on Plastic Deformation—E. Hornbogen, U. S. Steel Corp.

Activation Energies for Basal Slip in Magnesium Single Crystals—T. A. Trozera, J. Mote, and J. E. Dorn, University of California.

Cylindrical Textures in Tungsten and Other Body Centered Cubic Metals—Sam Leber, General Electric Co.

WEDNESDAY, OCT. 19
2 P.M.

STEEL III

Preferential Corrosion of Stabilized Stainless Steel Welds—C. L. Angerman and P. Kranzlein, Du Pont.

Metal Wear by Scoring—J. H. Olson and R. D. Chapman, Chrysler Corp.

Mechanism of Rapid Intergranular Oxidation of 18 Cr-8 Ni Stainless Steels by Oxygen and Dry Sodium Chloride in the Temperature Range 1100°-1400° F—M. G. Fontana, F. H. Beck, and H. W. Pickering, Ohio State University.

On the Hardenability Effect of Boron in Steel—R. A. Grange and J. B. Mitchell, U. S. Steel Corp.

The Determination of Hardness in Steels from the Breadth of X-Ray Diffraction Lines—R. E. Marburger and D. P. Koistinen, General Motors Corp.

2 P.M.

HIGH TEMPERATURE MATERIALS

The Constitution of Rhenium-Columbium Alloys—P. Levesque, W. R. Bekebrede, and H. A. Brown, Raytheon Mfg. Co.

Beta Transformation Characteristics of Titanium Alloyed with Vanadium and Aluminum—E. L. Harmon, Union Carbide Metals Co., and A. R. Troiano, Case Institute of Technology.

Mechanical Properties of Tantalum-Base Alloys—F. F. Schmidt, F. C. Holden, H. R. Ogden, and R. I. Jaffee, Battelle Memorial Institute.

A New Series of Nickel Base Alloys for Advanced Temperature Applications—J. C. Freche, W. J. Waters, and T. J. Riley, NASA Lewis Research Center.

High Strength Martensite Steels for Elevated Temperature Use—A. Kasak, V. K. Chandhok, and E. J. Dulis, Crucible Steel Co. of America.

Effects of Alloying on the Oxidation Behavior of Tantalum—W. D. Klopp, D. J. Maykuth, and R. I. Jaffee, Battelle Memorial Institute.

THURSDAY, OCT. 20
9 A.M.

NUCLEAR MATERIALS

Liquid Metal Fuel Constitution Part I: The Solubility of Uranium in Bismuth—D. G. Schweitzer and J. R. Weeks, Brookhaven National Laboratory.

Liquid Metal Fuel Constitution Part II: Liquidus Curves of the Uranium-Zirconium-Bismuth System — D. G. Schweitzer and J. R. Weeks, Brookhaven National Laboratory.

Alloying to Improve Ductility of Vanadium—D. T. Klodt and C. E. Lundin, University of Denver.

Structure and Mechanical Properties of Uranium—Titanium Martensites—D. L. Douglass, General Electric Co.

Effect of Low Alloy Additions on the Properties of Uranium—W. H. Friske, H. E. Kline, and M. H. Binstock, Atomics International.

2 P.M.

EMBRITTLEMENT

Temperature and Microstructure Dependence of Size Effects in Notched Bend Tests of Some Alloy Steels—S. Yukawa, General Electric Co.

Embrittlement of High Purity Nickel—K. M. Olsen, C. F. Larkin, and P. H. Schmitt Jr., Bell Telephone Laboratories Inc.

Influence of Hot Rolling Conditions on Brittle Fracture in Steel Plate—F. de Kazinczy, Oxelosunds Jarnverksaktiebolag, Sweden; and W. A. Backofen, Massachusetts Institute of Technology.

Effect of Induction Tempering on 500 Degree Embrittlement—A. Nakashima and J. F. Libsch, Lehigh University.

The Occlusion of Hydrogen by Annealed Hypoeutectoid Iron-Carbon Alloys—M. Kotyk and H. M. Davis, Pennsylvania State University.

On the Mechanism of Occlusion of Hydrogen by Cold Worked Hypoeutectoid Iron-Carbon Alloys—J. E. Werner and H. M. Davis, Pennsylvania State University.

Hydrogen Embrittlement in Vanadium-Columbium Alloys—A. L. Eustice and O. N. Carlson, Iowa State University.

ASM Metals Engineering Program Committee Sessions

Bellevue-Stratford Hotel

MONDAY, OCT. 17
9 A.M.

MATERIALS FOR THE AEROSPACE AGE

Properties of Materials for Aerospace Environments—E. Scala, Avco Corp.

New Fabrication Techniques for Aerospace Systems—Col. W. H. Grierson, U. S. Air Force.

Selection of Materials for Some Aerospace Systems—H. B. Probst, NASA Lewis Research Center.

2 P.M.

METAL JOINING

The Metallurgy of Heat Affected Weld Zones in HY-80 High Strength Steel—G. N. Emmanuel, D. E. Young, and G. L. Spahr, Babcock & Wilcox Co.

Welding of High Tensile Steels for Heavy Industrial Equipment — Robert Myer, Harnischfeger Corp.

Exothermic Brazing — Roger A. Long, Narmco Industries Inc.

TUESDAY, OCT. 18
9 A.M.

FAILURE ANALYSIS I

Failure of Steam-Water Heat Exchangers —B. H. Brown, U. S. Naval Research Laboratory.

Evaluation of Service Difficulties Involving Material Failure—Mrs. Joan B. Barriage, Federal Aviation Agency.

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ASM PROGRAM

TUESDAY, OCT. 18
9 A.M.

Analytical Procedures Used in Evaluating High Temperature Failures—W. R. Foley, Babcock & Wilcox Co.

2 P.M.

FAILURE ANALYSIS II

Evaluation of Corrosion Performance—R. J. Landrum, Du Pont.

Evaluation of Aircraft Material Performance by Fracture Mechanisms—W. E. Anderson, Boeing Airplane Co.; and P. C. Paris, University of Washington.

Engineering Approach to Service Performance—Prof. Charles Lipson, University of Michigan.

WEDNESDAY, OCT. 19
2 P.M.

RECENT ADVANCES IN METALLURGICAL MICROSCOPY

The Use and Application of the Electron Microscope in Metallurgical Problems—Prof. Jack Nutting, Cambridge University.

Quantitative Metallography—E. E. Underwood, Battelle Memorial Institute.

New Developments in Microscopy—Prof. J. W. Spretnak, Ohio State University.

THURSDAY, OCT. 20
9 A.M.

EFFECTS OF STRUCTURE ON PROPERTIES I

Microstructure vs. Notch Toughness of Manganese Hardened Steel—R. D. Stout and E. H. Kottcamp Jr., Lehigh University.

Fracture Toughness and Structure of High Strength Sheet Steels for Pressure Vessels—Harold Bernstein and G. C. Young, U. S. Naval Weapons Plant.

Heat Treatment Variables vs. Fracture Characteristics of Steels—P. P. Puzak, U. S. Naval Research Laboratory.

Structural Effects of Strengthening Low Alloy Steels by Deforming Austenite—R. A. Grange and J. B. Mitchell, U. S. Steel Corp.

Influence of Microstructural Features on the Corrosion Resistance of Several Metals and Alloys—A. M. Hall and W. K. Boyd, Battelle Memorial Institute.

2 P.M.

EFFECTS OF STRUCTURE ON PROPERTIES II

The Effect of Composition, Structure, and Processing on the Properties and Application of 20 to 80 Per Cent Nickel, Iron-Nickel Alloys—R. J. Raudebaugh, International Nickel Co.

Effect of Structure on Properties of Gray and Ductile Irons—Prof. I. F. Wallace, Case Institute of Technology.

AMP Alloys—R. J. Towner, Aluminum Co. of America.

A Study of Refinement of the Primary Silicon and the Eutectic in Aluminum -21 Per Cent Silicon Alloy—Yeshwant P. Telang, Ford Motor Co.; and Myron G. Urdea, Aerojet-General Corp.

Effect of Elevated Temperature Exposure on the Strength Properties and Microstructure of Rene 41 and Astroloy—D. P. Moon and W. F. Simmons, Battelle Memorial Institute; J. F. Barker, General Electric Co.

Microstructure vs. Properties of Titanium Alloys—E. Bohanek, Titanium Metals Corp.

ASM-AEC Conference

Bellevue-Stratford Hotel

MONDAY, OCT. 17
9 A.M.

URANIUM COMPOUND FUELS

Introduction—Julius Simmons, U. S. Atomic Energy Commission.

Refractory Fuel Compounds—R. F. Dickerson, Battelle Memorial Institute.

Preparation and Properties of Beryllides Containing Uranium—Speaker to be announced.

Fabrication and Properties of Uranium Mononitride—Donald Keller, Battelle Memorial Institute.

Development of Graphite-Matrix Fuels—Milton Janes, National Carbon Co.

2 P.M.

DEVELOPMENT OF URANIUM CARBIDE

Production of Uranium Carbide—Harry Pearlman, Atomics International.

Powder Metallurgy Fabrication of High Density Bulk Uranium Carbide—Herbert Kalish, Olin Mathieson Chemical Corp.

Skull Melting and Multiple Molding of Uranium Carbide—Ellis Foster, Battelle Memorial Institute.

Compatibility of Carbides with Cladding and Coolants—D. I. Sinizer, Atomics International.

Preparation of Zirconium-Uranium Carbide and High Temperature Properties—Melvin G. Bowman, Los Alamos Scientific Laboratory.

Symposium For Steel Users

Philadelphia Trade and Convention Center

TUESDAY, OCT. 18
2 P.M.

STAINLESS STEELS

What Is Stainless Steel—John J. B. Rutherford, Babcock & Wilcox Co.

What to Expect of Stainless—K. A. Matticks, Crucible Steel Co. of America.

Special Stainless Steels—Adolph J. Lena, Allegheny Ludlum Steel Corp.

Panel on Stainless Steel Fabrication—R. B. Gunia, U. S. Steel Corp., moderator; joining—G. E. Linnert, Armco Steel Corp.; machining—Peter Leckie-Ewing, Latrobe Steel Co.; forming—W. L. Keene, Superior Steel Div., Copperweld Steel Co.; heat treating—B. T. Lanphier, Carpenter Steel Co.; cleaning and finishing—S. P. Odar, Republic Steel Corp.

WEDNESDAY, OCT. 19
2 P.M.

TOOL STEELS

Problems in Machining Space Age Metals—M. C. Metzger and L. A. Hauser, Universal-Cyclops Steel Corp.

Recent Developments in Low Temperature Air Hardening Tool Steels—Neil J. Culp, Carpenter Steel Co.

Overcoming Distortion and Cracking in Heat Treating Tool Steels—Richard Harvey, Braeburn Alloy Steel Corp.

THURSDAY, OCT. 20
2 P.M.

JOINING HIGH STRENGTH STEELS

Eliminating Hot Cracking in Welding of SAE 4340 Steels—R. E. Monroe, Battelle Memorial Institute.

Welding "T-1" Steels—Louis Keay, Lukens Steel Co.

Welding Heat Treated, Low Alloy, High Strength Steels—Clarence Altenburger, Great Lakes Steel Corp.

ASM-IHEA Symposium

Bellevue-Stratford Hotel

TUESDAY, OCT. 18
9 A.M.

HEAT TREATING STAINLESS STEELS

Atmospheres and Furnaces for Heat Treating and Sintering Stainless Products—B. A. Ruediger, General Electric Co.

Brazing of Stainless Steel Assemblies—H. M. Webber, Harper Electric Furnace Corp.

Vacuum Furnaces for Processing Stainless Steels—Herbert Westeren, C. I. Hayes Inc.

Treatment of Stainless Flat Products—M. R. Ogle, Drever Co.

Treatment of Stainless Steel Tubes and Wire—C. H. Vaughn, Electric Furnace Co.

Metallurgical Society Of AIME

Sheraton Hotel

MONDAY, OCT. 17
9 A.M.

THERMODYNAMICS, PHASE EQUILIBRIA, STRUCTURE

Thermodynamics of Solid Fe—P. D. Anderson and R. Hultgren, University of California.

Phase Diagram of Bi_2Te_3-Sb_2Te_3 System—J. R. Wiese and R. Pyle, Franklin Institute.

Statistical Description of Phase Distribution—D. E. Gucer, Brown University.

Structural Study of Ag, Sb, Te_2—Speaker to be announced.

Miscible Laves-Type Compounds—J. B. Darby Jr., Argonne National Laboratory.

Isothermal Section of the Cr-Zr-O System at 1200° C—C. Hwu and Michael Hoch, University of Cincinnati.

Zr-Rich Corners of the Zr-Co-O and Zr-Ni-O Systems—M. V. Nevitt and J. W. Downey, Argonne National Laboratory.

AB_3 in Binary and Ternary Transition Element Systems—A. E. Dwight, Argonne National Laboratory.

Annealing vs. Structure of Pyrolytic Graphite—E. R. Stover, General Electric Co.

9 A.M.

ADVANCES IN STAINLESS STEEL METALLURGY I

Hardening in Armco 17-7 PH Stainless—A. E. Austin, G. K. Manning, and E. E. Underwood, Battelle Memorial Institute.

Influence of Carbides on Transformation of Semiaustenitic Stainless—G. N. Aggen and R. A. Lula, Allegheny Ludlum Steel Corp.

Carbides in Austenitic and PH Stainless—R. J. Bendure, L. C. Ikenberry, and J. H. Waxweller, Armco Steel Corp.

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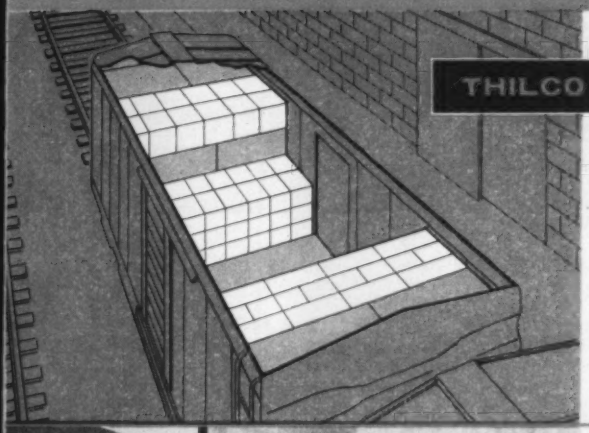

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ASM PROGRAM

MONDAY, OCT. 17
9 AM

Submicroscopic Structures in Tempering 410 Stainless—J. J. Hauser, J. M. Capenos, and B. R. Banerjee, Crucible Steel Co. of America.

Creep-Rupture—F. Garofalo, R. W. Whitmore, W. F. Domis, and F. von Gemmingen, U. S. Steel Corp.

9 A.M.
INGOT STRUCTURE CONTROL—I

Ingot Structure Control—W. A. Tiller, Westinghouse Electric Corp.

Solidification in Undercooled Metals—J. L. Walker, General Electric Co.

Segregation in Alloy Ingots—J. W. Holladay, Battelle Memorial Institute.

9 A.M.
DIFFUSION—I

Diffusion in Magnetic Materials—C. E. Birchenall, University of Delaware.

Self-Diffusion in Ag-Au Alloys—L. Slifkin, University of North Carolina; and W. Mallard, Emory University.

Simultaneous Plastic Strain—R. Balluffi, University of Illinois; J. Darby, Argonne National Laboratory; and C. Tomizuka, University of Arizona.

2 P.M.
IMPERFECTIONS, GRAINS, AND SURFACES

Direct Observation of the Dislocation Structure in an Al-A_2O_3 Alloy by Transmission Electron Microscopy—G. S. Ansell, Rensselaer Polytechnic Institute; and Erwin Eichen, Allegheny Ludlum Steel Corp.

Transmission Electron Microscopy Studies on Ultramicrotomed Metals—V. A. Phillips, General Electric Co.

Radiation Hardening in Cu Single Crystals—I. G. Greenfield and H. G. F. Wilsdorg, Franklin Institute.

Direct Observations on Twinning and Grain Growth in Austenite by Thermionic Emission Electron Microscopy—W. L. Grube and S. R. Rouze, General Motors Corp.

Cine Photomicrographic Studies of Metal Whisker Growth—W. J. Allan and W. W. Webb, Union Carbide Corp.

Dislocations in Zn—V. V. Damiano and G. S. Tint, Franklin Institute.

Dislocation Etch Pits on (0001) Surface of Zn Crystals—H. S. Rosenbaum and M. M. Saffren, General Electric Co.

Surface Markings on Al—J. M. Lommel, General Electric Co.

Etch-Pit Characteristics of Mo—M. A. Adams and A. Iannucci, Materials Research Corp.

Primary Oxide Films on Molten Metals—Electron Diffraction Study—G. Shimaoka, National Research Institute.

Technique for Studying Oxide Films on Al—P. E. Doherty, P. C. Johnson, and R. S. Davis, Arthur D. Little Inc.

2 P.M.
ADVANCES IN STAINLESS STEEL METALLURGY—II

Composition vs. Stress—Corrosion Cracking—D. van Rooyen, Westinghouse Electric Corp.

Subzero Rolling of Stainless—D. W. McDowell and J. R. Mihalisin, International Nickel Co.

Temperature Dependent Fatigue in Cr Steels with Delta Ferrite—V. K. Chandhok and E. J. Dulis, Crucible Steel Co. of America.

Effect of B on Hot Ductility in Austenitic Stainless—F. K. Bloom and E. E. Denhard, Armco Steel Corp.

Effect of Delta Ferrite on Hot Cracking—F. C. Hull, Westinghouse Electric Corp.

2 P.M.
INGOT STRUCTURE CONTROL—II

Small Scale Experiments as Full Scale Production—B. Chalmers, Harvard University.

Unidirectional Solidification of Steel Ingots—M. C. Flemings, S. Z. Uram, R. V. Barone, and H. F. Taylor, Massachusetts Institute of Technology.

Mathematical Description of Solidification—E. L. Foster, B. Fletcher, and C. K. Franklin, Battelle Memorial Institute.

2 P.M.
DIFFUSION—II

Quantum Effects on Diffusion of H in Metals—W. R. Heller, International Business Machines Corp.

Solubility and Diffusivity of H in Mo—M. L. Hill, Johns Hopkins University.

Diffusion in a Ferromagnetic Alloy—James Stanley and C. A. Wert, University of Illinois.

Self-Diffusion of Fe and S in Ferrous Sulfide—R. H. Condit, University of California.

Internal Friction of Cold Worked and Quenched Steel—I. Tamura, Osaka University; T. Mura and J. O. Brittain, Northwestern University.

Diffusion in Liquid Amalgams—P. C. Mangelsdorf Jr., University of Chicago.

Internal Friction in Liquid Metals—G. Abowitz, Cornell University; and R. B. Gordon, Yale University.

Self-Diffusion of Ge in Pure and Doped Crystals—H. Widner, G. R. Gunther-Mohr, and A. S. Nowick, International Business Machines Corp.

Thermal Diffusion in NonStoichiometric Zirconium Dihydride—A. W. Sommer and W. F. Dennison, Atomics International.

Thermodynamics of Diffusion—R. W. Keyes, International Business Machines Corp.

Hydrostatic Pressure vs. Self Diffusion in Ph—J. B. Hudson, General Electric Co.

2 P.M.
METALLURGY IN THE ARMY—Requirements, Uses, Research

Introductory Remarks—W. J. Ely, Army Research Office.

Metallurgical Research in Europe—L. G. Klinker, Army Research Office.

Light Armor Materials—H. P. George, Frankford Arsenal.

Point Defects in Pure Ni—J. J. Antal and Allen Goland, Ordnance Materials Research Office.

Dilute Binary Transition Element Solutes in Fe—E. P. Abrahamson, Watertown Arsenal.

High Pressure—High Temperature Piston Assembly—A. A. Giardini and J. E. Tydings, U. S. Army.

TUESDAY, OCT. 18
9 A.M.
TITANIUM

Phase Transformation During Heat Treatment of Ti-6 Al-4 V—P. J. Fopiano, Mfg. Laboratories Inc.; M. B. Bever and B. L. Averbach, Massachusetts Institute of Technology.

Grain Boundary Segregation of C, N, O in Ti—I. Winter, Olin Mathieson Chemical Corp.; and I. Cadoff, New York University.

Zone Refined Ti—G. E. Spangler and M. Herman, Franklin Institute.

Deformation Textures of Ti—P. A. Albert, Westinghouse Electric Corp.; C. Liu, Ford Motor Co.; and I. Cadoff, New York University.

9 A.M.
PHASE TRANSFORMATION

Martensite (225) Transformation in Fe—C. M. Wayman and T. A. Read, University of Illinois; J. E. Hanafee, International Nickel Co.

Martensitic Transformation in Fe Single Crystals—J. F. Breedis and W. D. Robertson, Yale University.

Isothermal Transformation of Austenite by Thermionic Emission Electron Microscopy—S. R. Rouze and W. L. Grube, General Motors Corp.

Stress Induced Martensitic Transformation of Austenitic Stainless Low Temperature—R. P. Reed, C. J. Guntner, and R. L. Greeson, National Bureau of Standards.

Transformation of Gray-Tin Single Crystals—R. G. Wolfson, M. E. Fine, and A. W. Ewald, Northwestern Univeristy.

Physical Damage to Plutonium from Thermal Cycling—R. D. Nelson, General Electric Co.

9 A.M.
PROCESS SIMULATION

Predicting Blast Furnace Operation with Computer—A. L. Hodge, Linde Co.

Correlation Analysis of Roof Lance Operations in Open Hearth—A. P. Woods, Armco Steel Corp.

Computer Simulation of Melt Shop Operation—A. Neate and W. J. Dacey, Steel Co. of Wales Ltd.

9 A.M.
EFFECT OF EXTREMELY HIGH PRESSURES—I

Static Pressure Research in Metallurgy—J. E. Hilliard, General Electric Co.

Phase Transitions of Pure Metals at High Pressures—G. C. Kennedy, University of California.

Shock Waves in High Pressure Studies—G. R. Cowan, Du Pont.

2 P.M.
TITANIUM VS. STEEL AND ALUMINUM IN PRESSURE VESSELS

Evaluation of Fracture Toughness—W. S. Pellini and J. E. Srawley, U. S. Naval Research Laboratory.

Pressure Vessels for Space—V. W. Cooke and R. C. Powell, Pratt & Whitney Co. Inc.

Ductility in Aerospace Pressure Vessels—G. Gerard, New York University.

Pressure Vessels for Hydrospace—G. Sorkin, U. S. Navy.

Film: "March of Titanium"—Titanium Metals Corp.

2 P.M.
PANEL DISCUSSION ON HOT EXTRUSION

Introduction — P. Loewenstein and A. Geary, Nuclear Metals Inc.

Lead—F. A. C. Shaw, American Smelting & Refining Co.

Aluminum—M. E. Molitor, Kaiser Aluminum & Chemical Corp.

Magnesium—To be announced.

Copper—T. S. Howald, Chase Brass & Copper Co. Inc.

Nuclear Materials—A. White, Nuclear Metals Inc.

Summary—P. Loewenstein, Nuclear Metals Inc.

(*Please turn to Page* 176)

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the case
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Material Evidence — NOBODY PUTS AS MUCH INTO A WELDING MACHINE AS A. O. SMITH

To prove our case — that only A. O. Smith still makes an Extra-Heavy-Duty welding machine—we've put our evidence on the table. We submit that, while other machines have been "trimmed down" to sell for less, A. O. Smith Extra-Heavy-Duty welders have all the "guts" the old-timers had. That there has been no stinting on copper, iron or power. That there has been no attempt to cut corners on materials and components—no compromise with value to meet a price.

Examine the evidence! Then make your own value analysis. We are sure that the verdict will be in favor of A. O. Smith — that it's sound judgement to pay a little more for much more machine. Analyze the value when you consider the price. It's value that pays off in longer life and superior performance.

EXHIBIT A — COILS A. O. Smith's extra-heavy copper secondary (at left) and primary (at right) coils are the heaviest in the field — together weigh 185 lbs. Note how competitive coils skimp on material. Here's heavy-duty value that adds up to longer production life . . . a machine that operates on a temperature rise of only 55°C — lowest of any machine on the market.

EXHIBIT B — CAPACITORS Standard with A. O. Smith Extra-Heavy-Duty welders is the industry's maximum power factor correction — 134 M.F.D. total. This high power factor means that the current taken from the primary line is lower than with any other machine when comparable ratings are matched — value that means money in your pocket through lower power bills.

EXHIBIT C — MOTOR Power behind the A. O. Smith extra-heavy-duty cooling system is big, totally enclosed lifetime-lubricated motor. Note "junior-size" motors used by competitive welders. Only A. O. Smith's heavy-duty motor supplies dependable starting torque . . . provides more air for cooler operation and longer machine life.

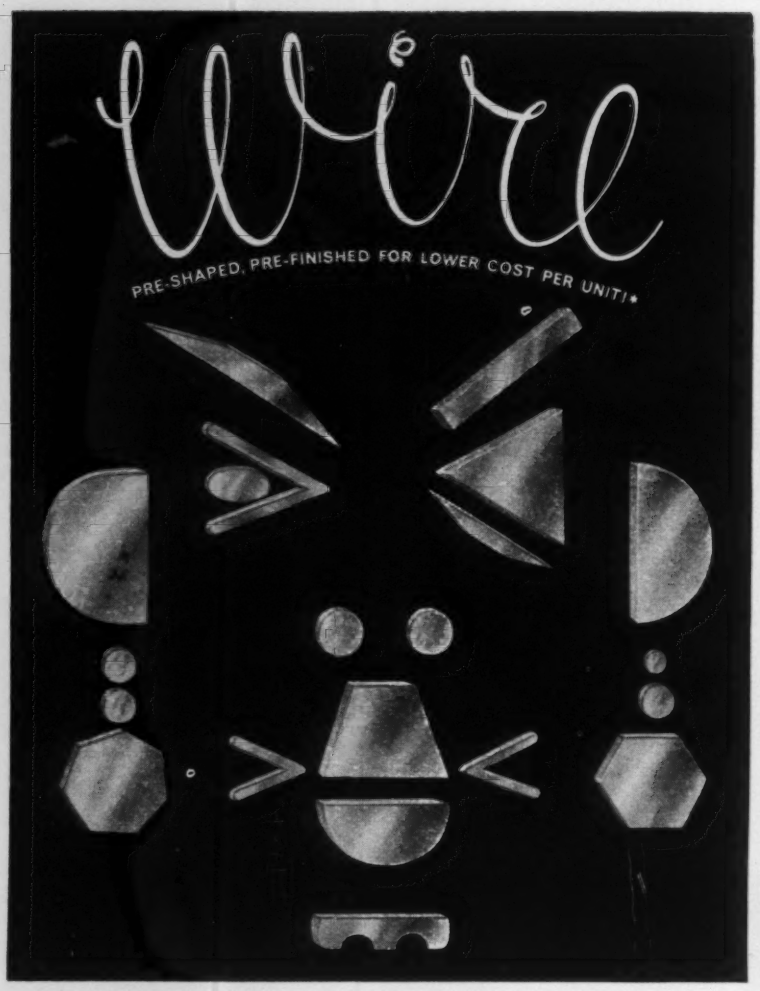
EXHIBIT D — FAN Biggest fan in the field. Air is circulated by an 18-inch industrial-type fan blade as compared to fans much smaller on other welding machines. And A. O. Smith's blade is dynamically balanced, scientifically pitched to deliver maximum ventilation down through the coils. Blast guides direct full force of the fan right on target.

COURT CALENDAR

Case for value analysis — A. O. SMITH EXTRA-HEAVY-DUTY welding machine versus the field. Exhibits shown in front row on table are principal components used in the standard A. O. Smith EXTRA-HEAVY-DUTY welding machine. Comparable components used in other well known brand welding machines are displayed in rear rows.

Through research ... a better way

A.O.Smith
CORPORATION
WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin
A. O. Smith INTERNATIONAL S.A., Milwaukee 1, Wis., U.S.A.



*Examples shown are greatly enlarged cross-sectional views of selected standard and special shapes available

The right shape plus the right finish equals lower production costs

with CONTINENTAL® round and special shaped wire

Face up to the pleasant fact that you can often shave your production costs appreciably—and win extra sales—by choosing the right shape in wire. You save because you eliminate forging, stamping, rolling or machining operations. What's more, you can get these ready-made shapes (and many others than shown) in bright, galvanized, coppered, liquored, or tinned finishes that save further in polishing and plating. If you use low and medium low carbon steel wire in any shape, form or finish, by all means learn what Continental can offer you. We have solved literally thousands of problems involving wire. We'd love to have a shot at solving yours.

Write for free copy of our new wire manual

CONTINENTAL STEEL
CORPORATION KOKOMO, INDIANA

PRODUCERS OF: Manufacturer's Wire in many sizes, tempers, and finishes, including Galvanized, KOKOTE, Flame Sealed, Coppered, Tinned, Annealed, Liquor-Finished, Bright and special shaped wire. Also Welded Wire Reinforcing and Galvanized Fabric, Nails, Continental Chain Link Fence, and other products.

ASM PROGRAM

(*Continued from Page 172*)

TUESDAY, OCT. 18
2 P.M.

PHYSICAL CHEMISTRY

McWane Process for Making Iron—T. E. Ban, McDowell Co. Inc.; and B. W. Worthington, McWane Cast Iron Pipe Co.

Kinetics of Iron Oxide Reduction—A. Wilhelem and G. St. Pierre, Ohio State University.

Sulfide Inclusions in Steel—L. van Vlack, D. K. Riegger, R. J. Warrick, and J. M. Dahl, University of Michigan.

Phase Equilibrium of Synthetic Nonmetallics in FeO-MnO-MnS-SiO_2 System—E. H. Silverman, U. S. Steel Corp.

Chromium vs. S Activity in Liquid Fe—N. R. Griffing and G. W. Healy, Union Carbide Corp.

2 P.M.

EFFECTS OF EXTREMELY HIGH PRESSURES II

Phase Transformations in Fe-C System—S. V. Radcliffe, M. Schatz, and S. A. Kulin, Mfg. Laboratories Inc.

Shock Pressure Induced Phase Transition in Fe—P. C. Johnson, B. A. Stein, and R. S. Davis, Arthur D. Little Inc.

Phase Changes in Fe by Differential Thermal Conductivity—W. F. Claussen, General Electric Co.

Phase Transitions in Solidified Gases—J. W. Stewart, University of Virginia.

Recrystallization—L. E. Tanner and S. A. Kulin, Mfg. Laboratories Inc.

Age Hardening Characteristics of Cu-Be-Ni Alloys—V. A. Phillips, General Electric Co.

X-Ray Diffraction—L. S. Kasper, General Electric Co.

Residual Effects of Pressure and X-Ray Diffraction of Al Single Crystals—R. E. Zumwalt, L. P. Skolnick, and J. R. Ferron, University of Delaware.

Annealing LiF, Al, Cu, Fe—I. E. Hilliard, J. M. Lommel, J. B. Hudson, D. F. Stein, and J. D. Livingston, General Electric Co.

Deformation of Al and Cu Single Crystals—C. M. Glass, Ballistic Research Laboratories.

Shock Induced Transition in Fe-Base Alloys—E. G. Zukas, E. S. Minshall, and C. M. Fowler, Los Alamos Scientific Laboratory.

WEDNESDAY, OCT. 19
9 A.M.

DIFFUSION CONTROLLED PROCESSES

Grain Boundary Migration in Pb—J. L. Walter, General Electric Co.

Grain Boundary Relaxation in Al-Al_2O_3 Alloy—G. S. Ansell and P. E. Arnold, Rensselaer Polytechnic Institute.

Anelastic Behavior of a Dilute Al-Mg Alloy—B. S. Berry, International Business Machines Corp.

Effect of NiO Dispersions on Oxidation of Copper—J. A. Sartell and C. H. Li, Minneapolis-Honeywell Regulator Co.

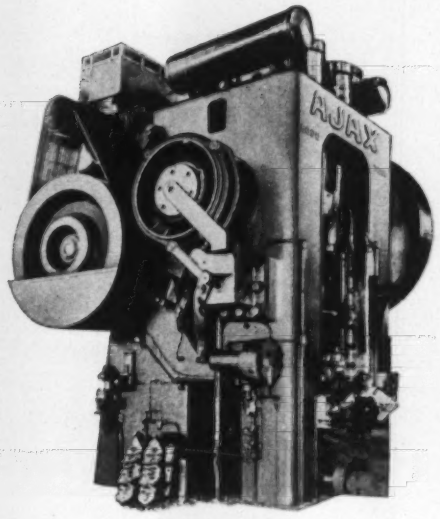
Oxidation of Thin Metallic Films at High Temperature—G. Shimaoka, National Research Institute.

Surface Graphitization of Fe-C Alloys—G. R. Speich, U. S. Steel Corp.

Diffusion of Interstitials in Ceramic-Refractory Metal Composites—M. L. Hill, Johns Hopkins University.

the Ajax line

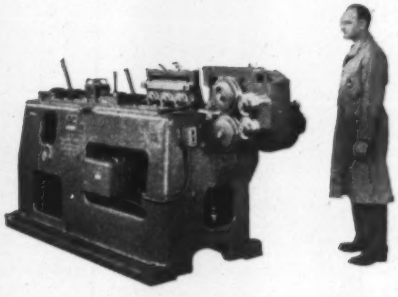
OF METAL WORKING MACHINES



"HIGH SPEED" FORGING PRESSES

Built in 13 sizes from 300 to 8000 tons capacity. Ajax Presses are built with massive, solid, mill housing-type steel frames. Rigid frames assure excellent alignment and accurate die match for the production of uniform and accurate forged parts.

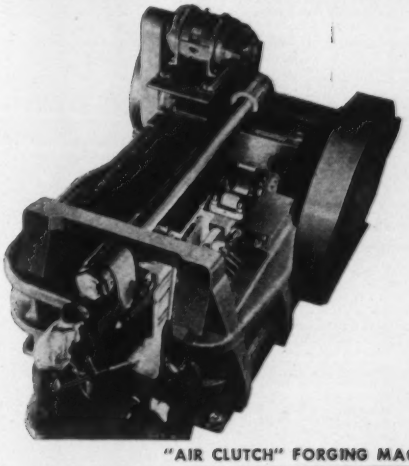
Write for Bulletin 75-C



AJAX-HOGUE WIRE DRAWERS

An attachment for any size cold header and parts former. It cold draws wire in a straight line from hot-rolled stock instead of cold-drawn wire. You save the difference in cost of material and at the same time produce the highest quality cold-headed parts.

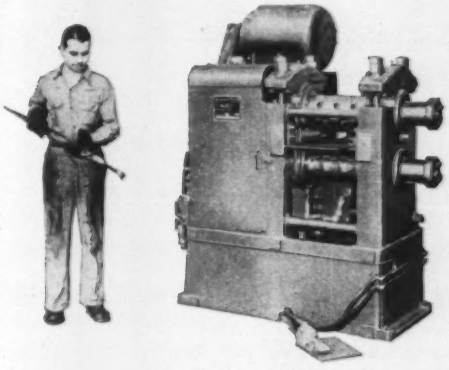
Write for Bulletin 111-B



"AIR CLUTCH" FORGING MACHINES

Choose from a complete line of forging machines—Sizes 1" to 12" to make the forged parts you need . . . Transmission gears —Flanged axle shafts—Crankshaft flanges—Jet Blade Blanks—Implement & Tractor forgings. There's an Ajax Forging Machine for every field of upset forging in industry.

Write for Bulletin 65-D



"WIDE ADJUSTMENT" FORGING ROLLS

Pre-roll your forging blanks for metal saving—longer die life—and better fibre flow. Ajax Rolls are available in 7 sizes to pre-roll forging blanks ranging from connecting rod blanks to the largest propellers. Extension shafts with overhanging dies permit rolling long work.

Write for Bulletin 91-B

SERVING THE FORGING INDUSTRY SINCE 1875

THE Ajax MANUFACTURING COMPANY

1441 CHARDON RD. CLEVELAND 17, OHIO

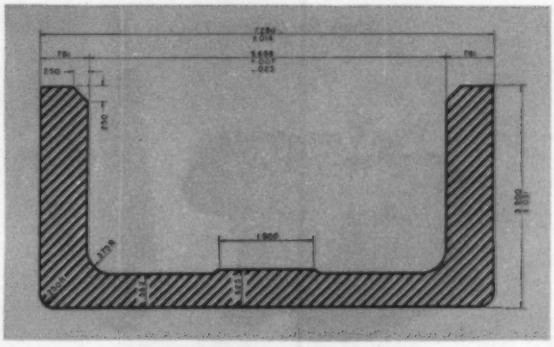
CHICAGO OFFICE: 110 S. DEARBORN STREET CHICAGO 3, ILLINOIS

WOOLDRIDGE CO. • BURLINGAME, CAL. • LOS ANGELES 22, CAL.

CONNORS special sections at Towmotor...

"We increased our production efficiency 25% with Connors Special Sections," says Mr. Richard S. Wentz, Vice President, Towmotor Corporation

"By working with Connors Special Sections Engineers, we have gone a long way in improvements in product design and styling," Mr. Wentz says. "The flexibility of the Connors mill has enabled our engineers to design sections which in the past were considered impractical from a mill standpoint, yet highly desirable to our engineering and production departments."



Towmotor had been machining the height, the inside face and the 45 degree chamfer on their mast channel section. These operations were eliminated by a special section rolled by Connors providing the dimensions required as well as other desirable features.

Let Connors Special Sections work for you.

For illustrated brochure or consultation write or call Connors — Specialists in Special Sections

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PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

ASM PROGRAM

WEDNESDAY, OCT. 19
9 A.M.

METALLIC MODERATORS AND CLADDING MATERIALS—I

Zircaloy Tubing for Cladding Nuclear Fuel—R. C. Aungst, K. M. Haws, and P. L. Farnsworth, General Electric Co.

Zircaloy-2 Tubing—H. H. Klepfer and C. N. Spalaris, General Electric Co.

Zircaloy-4—J. N. Chirigos, S. Kass, W. W. Kirk, and G. J. Salvaggio, Westinghouse Electric Corp.

Hydriding Process for Zr Alloys—R. E. Westerman, General Electric Co.

Zr Cladding Alloys for Pressurized Water Reactors—D. L. Douglass, General Electric Co.

Zr Alloys for Cladding Fuel Elements—R. K. Wagner, Atomics International.

High Temperature Cladding Alloys—J. F. Collins and J. A. McGurty, General Electric Co.

Aluminum Powder Metallurgy Products—E. G. Kendall and W. H. Friske, Atomics International.

9 A.M.

GASES IN METALS

Control of Oxygen in Copper—W. F. Harris and J. Easha, Westinghouse Electric Corp.

Effect of H on Mechanical Properties of Mo—W. Liebmann, Radio Corp. of America.

Hydrogen Yield Point in Fe—M. L. Hill, Johns Hopkins University.

Effects of H in Fe—A. S. Tetelman, C. N. J. Wagner, and W. D. Robertson, Yale University.

Trapping H in Cold Worked Steel—H. H. Podgurski, U. S. Steel Corp.

Precipitation of He in Al—G. T. Murray, Materials Research Corp.

Helium in Uranium—A. Boltax, Westinghouse Electric Corp.

9 A.M.

SYMPOSIUM:
AUSTENITE DECOMPOSITION—I

Nucleation in Solid-Solid Transformations—J. N. Hobstetter, University of Pennsylvania.

Diffusion Growth in Solid-Solid Transformations—J. S. Kirkaldy, McMaster University.

Pearlite Reaction—J. W. Cahn and W. C. Hagel, General Electric Co.

Pearlite Formation—M. Hillert, Swedish Institute for Metals Research.

Electromicroscopic Study of Pearlite Reaction—L. S. Darken and R. M. Fisher, U. S. Steel Corp.

9 A.M.

PHYSICAL AND MAGNETIC PROPERTIES

High Conductivity Cu-Zr Alloys—M. J. Saarivirta, Amco Research & Development Inc.

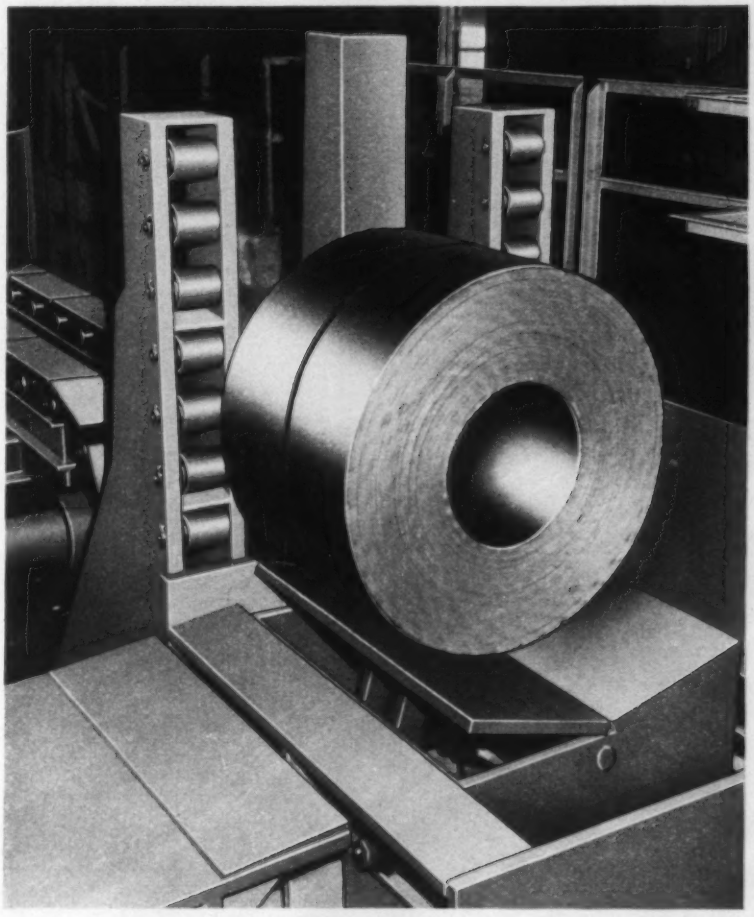
Electrical Conductivity of Non-Stoichiometric Cb_2O_5—E. H. Greener, D. H. Whitmore, and M. E. Fine, Northwestern University.

Electrical Resistivity of Liquid Na, and Liquid Li—J. F. Freedman, International Business Machines Corp.; and W. D. Robertson, Yale University.

Compressibility of Liquid Alloys—R. B. Gordon, Yale University; and Gerald Abowitz, Cornell University.

(Please turn to Page 182)

MATHEWS . . . A fully integrated conveyer service for the Metalworking Industries



• With 3 large modern plants, competent people in engineering and manufacturing, and 55 years of experience in mechanized handling, Mathews makes available to American and Canadian manufacturers a conveyer service complete in every detail, from proposal engineering through installation.

That is why we can confidently say, when you buy Mathews Conveyers you're sure to get outstanding performance.

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WESTERN DIVISION ..... MATHEWS CONVEYER COMPANY WEST COAST
San Carlos, California

CANADIAN DIVISION ..... MATHEWS CONVEYER COMPANY, LTD.
Port Hope, Ontario, Canada

Over Fifty Years of Leadership in Mechanized Handling

MATHEWS

Missile's "Fast Draw" Starts

Cold-drawn Seamless Cuts Clean-up Costs For Anker-Holth's Power Cylinders

The Missile Age version of the "fast draw" starts with the lightning stroke of a power cylinder.

Big, 12-foot stroke hydraulic cylinders provide the power and speed that unsheath one of the nation's principal defense missiles for instantaneous action.

They're made by Anker-Holth Division of The Wellman Engineering Company from Pittsburgh Steel Company's commercial quality, carbon steel, Seamless Mechanical Tubing.

Mounted two to a unit, the husky cylinders must—within seconds, and without fail—slide back the two halves of the hangar-size missile shelter to release the weapon for firing.

Anker-Holth, of Port Huron, Mich., uses Pittsburgh Steel's Seamless Mechanical Tubing to manufacture this critical unit's outer cylinder and piston rod.

Relies on Pittsburgh—What makes this company rely on Pittsburgh Steel for the tubing it requires for this application?

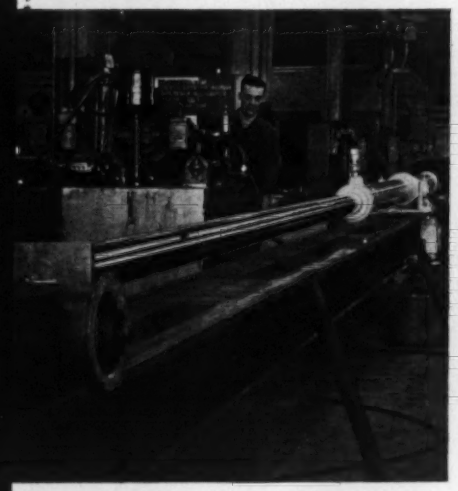
Fred J. Theisen, vice president-production, says there are several reasons. He explains:

"First is Pittsburgh Steel's service. They're able to give us information fast.

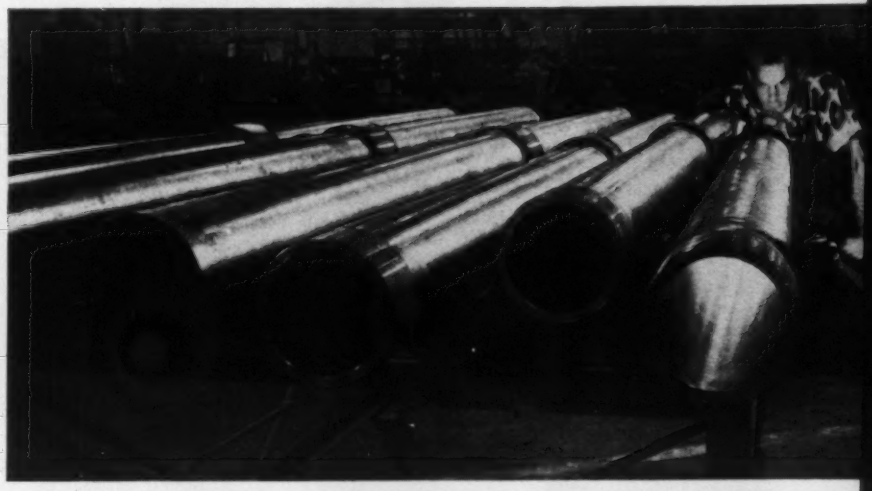
"On the first lot of tubing for this job, we asked all our suppliers for recommended sizes for cleanup to our finished dimensions. Pittsburgh

Piston rod made by Anker-Holth for launcher shelter's roof activating cylinder requires only minimum processing for cleanup with commercial quality Pittsburgh Steel Seamless Mechanical Tubing. Finished rods, 142" long, are plated with hard chrome. Vice president-Production Fred J. Theisen, (left) talking with Pittsburgh Steel salesman T. J. Whan, says Anker-Holth relies on Pittsburgh Steel tubing for this missile component.

With Pittsburgh Steel's Tubing



Final hydraulic testing on completed cylinders is comprised of 30 cycles at 4,500 psi—using special Anker-Holth testing equipment.



Fast service, straightness, and minimum stock removal convinced Anker-Holth that "Pittsburgh was best we could get for this job." Cylinder measures 5 inches by 4 inches by 143 inches. Anker-Holth specializes in power cylinders with bores from one to 48 inches, and strokes to 45 feet.

Steel's answer was in first, and it suggested less stock removal.

"That's important, and it's one reason Pittsburgh Steel stays with us. We ask them for size recommendations that we need for cleanup. They tell us the size, and they do it in a hurry. They don't wait around for a couple of months to reply.

"For another thing, when we first started production of this cylinder, we had a problem of straightness.

"I don't know how they did it, but Pittsburgh Steel came through with a batch of tubing I had never seen the equal of. Pittsburgh makes a quality tube. Straightness is the big thing—plus service and the amount of stock we must remove. With Pittsburgh Steel Seamless Tubes we don't need extra metal for honing—so we aren't paying for metal we don't use."

Experience Pays—Close attention to customers' needs and experience, plus steelmaking skills and production practices developed in nearly 50 years of seamless tube production, make Pittsburgh Steel able to serve Anker-Holth this way.

In this instance, Pittsburgh Steel's ability to produce commercial quality cold-drawn seamless mechanical tubing to exacting standards for straightness, concentricity and tolerances, allows Anker-Holth to simplify its cleanup process of the cylinder's ID and centerless grinding of the piston rod's OD.

Machinability and weldability of Pittsburgh Steel's tubing are vital factors in Anker-Holth's production, too, because plugs, ports, sleeves, piston and end covers are threaded and/or welded to the piston rod and cylinder in this application.

Contact one of the distributors or district sales offices listed below. Then let Pittsburgh Steel Company demonstrate its ability and readiness to help. You, too, will find that Pittsburgh Steel's tubing is the best you can get.

Pittsburgh Seamless Distributors

Baker Steel & Tube Company
Los Angeles, California
Chicago Tube & Iron Company
Chicago, Illinois
Cleveland Tool & Supply Co.
Cleveland, Ohio
Drummond, McCall & Co., Ltd.
Montreal, Quebec, Canada
Edgcomb Steel Company
Philadelphia, Pennsylvania
Gilmore Steel & Supply Co.
San Francisco, California
Earle M. Jorgensen Co.
Perry Kilsby, Inc.
Los Angeles, California
Mapes & Sprowl Steel Co.
Union, New Jersey
Metal Goods Corporation
St. Louis, Missouri
Miller Steel Company, Inc.
Hillside, New Jersey
A. B. Murray Co., Inc.
Elizabeth, New Jersey
C. A. Russell, Inc.
Houston, Texas
Ryerson, Joseph T. & Son, Inc.
Chicago, Illinois
Solar Steel Corporation
Cleveland, Ohio
Standard Tube Sales Corp.
Brooklyn, New York
Steel Sales Corporation
Chicago, Illinois
Tubular Sales
Detroit, Michigan
Tubular Service Corp.
Springdale, Pennsylvania
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Boston, Massachusetts
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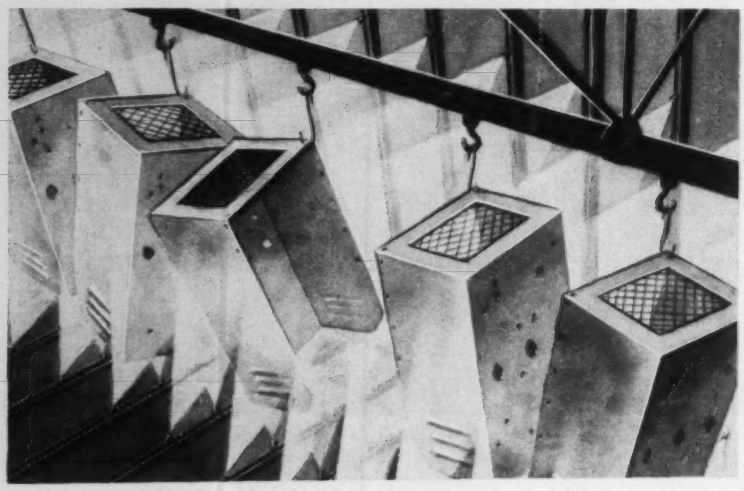
Steel

For tough steel cleaning jobs

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 SERVICE MEN • OVER 160 MATERIALS



New acid cleaner Oakite 86 gives fast smut removal... good paint grip

Shop smuts on steel parts disappear fast with Oakite 86 in the washing machine. A superior acid detergent, it removes all kinds of soils efficiently—really goes to work on heavily smutted steel. In addition, it forms a conversion coating on steel surfaces to give a good grip on subsequent paint coats ... helps inhibit corrosion.

Oakite 86 also works well when aluminum, zinc, brass and terneplate pass through the washer.

And it is just the latest in a complete line of Oakite materials for spray washing machines. Others include products for high-pressure spraying, for rapid cleaning, for heavy-duty cleaning, for low-heat cleaning, for conversion coatings. Ask the Oakite man which one will work best with your machines, your metals, your specific jobs. Or, write for FREE bulletin. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

SCIENCE

over 50 Est. 1909 years' leadership in industrial cleaning

ASM PROGRAM

(Continued from Page 179)

WEDNESDAY, OCT. 19

9 A.M.

Lattice Strains and X-Ray Stress Measurement—M. J. Donachie, General Dynamics Corp.; and J. T. Norton, Massachusetts Institute of Technology.

Magnetization of Alpha and Sigma Phase in Fe-V Alloys—M. V. Nevitt, Argonne National Laboratory.

2 P.M.

REFRACTORY ALLOY SHEET

A series of presentations on Department of Defense Refractory Metal Sheet Program.

2 P.M.

METALLIC MODERATORS AND CLADDING MATERIALS—II

Diffusion of H in Alpha-Delta Zircaloy-2—J. Markowitz, Westinghouse Electric Corp.

Metal Hydrides for Nuclear Applications—W. M. Mueller and J. P. Blackledge, Denver Research Institute.

Properties of Yttrium Hydride—E. S. Funston, General Electric Co.

Zr-H System—J. B. Vetrano and D. F. Atkins, Atomics International.

Properties of Zirconium Hydride—W. M. Mueller and R. L. Beck, Denver Research Institute.

Compatibility of Zirconium Hydride and CO_2—H. E. Shoemaker, General Atomic.

Cladding of Zirconium Hydride—E. S. Hodge and S. J. Paprocki, Battelle Memorial Institute.

2 P.M.

STRUCTURAL MATERIALS IN CRYOGENIC DESIGN

Design Criteria for Cryogenic Tanks—R. E. Jacobsen, Boeing Airplane Co.

Design Criteria for Airborne Tanks—R. Markovich, Martin Co.

Cryogenic Structural Materials—E. W. Johnson, Aluminum Co. of America.

Aerospace Materials at Low Temperatures—J. Watson, Convair Div. of General Dynamics Corp.

Temperature vs. Fracture Testing of High Strength Sheet—J. E. Srawley, U. S. Naval Research Laboratory.

Evaluating Relative Notch Sensitivity of High Strength Sheet—W. F. Brown, National Aeronautics & Space Administration.

2 P.M.

SYMPOSIUM: AUSTENITE DECOMPOSITION—II

Role of Partition in Austenite Decomposition—R. I. Entin, Central Research Institute, Moscow.

Thermodynamics of Bainite Reaction—L. Kaufman, Mfg. Laboratories Inc.; S. V. Radcliffe and M. Cohen, Massachusetts Institute of Technology.

Proeutectoid Ferrite and Cementite, and the Bainite Reactions—H. I. Aaronson, Ford Motor Co.

Growth Kinetics of Bainite Reaction—G. R. Speich, U. S. Steel Corp.

Surface Relief Effects in Ferrite and Bainite Plate Formation—J. W. Christian, Oxford University, England.

Proeutectoid, Eutectoid, and Peritectoid Transformation in Nonferrous Systems—C. W. Spencer, Cornell University.

2 P.M.

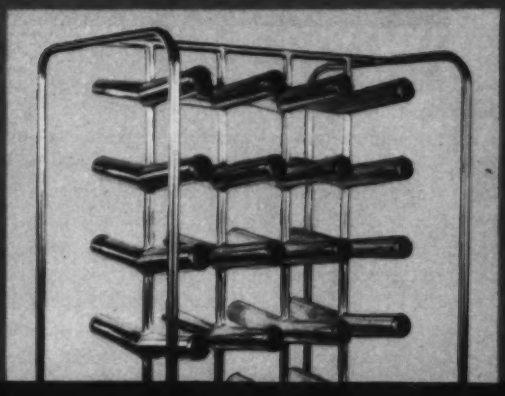
PLASTIC DEFORMATION—I

Frictional Stress on a Moving Dislocation—K. Wilsdorf, University of Pennsylvania.

you can bend it...

you can form it...

you can weld it...



but you can never, no never, change its **consistent uniformity!**

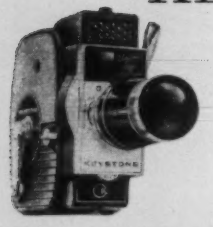
...no matter what test you put it to, you'll get consistent performance, greater output, better quality and more profit with Carpenter Specialty Stainless,...produced by one of the leaders of stainless steels for industry.

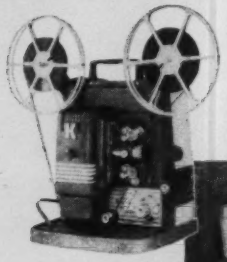
Carpenter steel

you can do it ***consistently*** better with Carpenter Stainless Steels for specialists

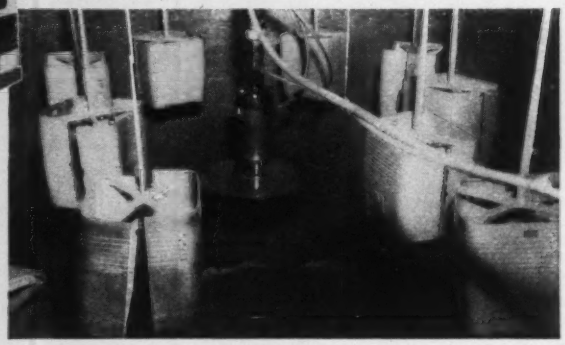
The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

KEYSTONE CAMERA Relies on RANSBURG No. 2 Process Electrostatic Spray Painting





to get the high quality wrinkle finish on cameras and projectors



Projector covers rotate as the conveyor makes a loop around the ceiling-mounted Ransburg No. 2 Process reciprocating disk. Electro-Spray is providing large paint savings on this wrinkle application, and permits Keystone to meet increased production requirements.

Keystone Camera Company, Inc. adheres to a strict quality control program—from start to finish—in the production of their widely-distributed, high quality home movie products. That's one reason for using the Ransburg No. 2 Process to apply a uniform wrinkle finish on their cameras and projectors.

IMPROVED QUALITY AND LARGE PAINT SAVINGS TOO

Together with the improved quality and greater uniformity in their finish, Keystone reports large paint savings over former air hand spray. Rejects which used to run 7%, or more, are reduced to less than 1%. Too, Ransburg No. 2 Process has enabled their finishing department—often a bottleneck in production—to meet steadily increasing production requirements without resorting to expensive overtime. Now, with the automatic No. 2 Process, they can turn out more projector covers in an hour than one operator formerly painted in a day. And, assembled cameras are painted five times faster with Electro-Spray. As a result of these desirable advantages—coupled with even higher production schedules—another Ransburg No. 2 Process unit was authorized for a second, identical production line at Keystone.

NO REASON WHY YOU CAN'T DO IT, TOO

Let us show you how Ransburg No. 2 Process can improve the quality of YOUR painted products, and at the same time, cut YOUR paint and labor costs. Send for our No. 2 Process brochure. Or, if your production doesn't justify automatic painting, let us tell you about the No. 2 Process Electrostatic Hand Gun which can be used in either conveyorized or non-conveyorized painting.

RANSBURG

RANSBURG Electro-Coating Corp.

Box 23122, Indianapolis 23, Indiana

ASM PROGRAM

WEDNESDAY, OCT. 19
2 P.M.

Easy Glide and Grain Boundary Effects in Al—R. L. Fleischer, General Electric Co.; W. F. Hosford, Massachusetts Institute of Technology.

Rupture of Surface Films on Al Crystals—R. J. Clock and M. Metzger, University of Illinois.

Latent Hardening in Al—U. F. Kocks, Harvard University.

Interactions Between Dislocation Families—B. H. Kear, Franklin Institute.

Microcreep in Zn Single Crystals—J. M. Roberts and W. March, Rice University; Norman Brown, University of Pennsylvania.

Easy Glide in Pb Single Crystals—R. L. Fleischer, General Electric Co.

Plastic Deformation of Pb Single Crystals—G. F. Bolling, L. E. Hays, and H. W. Wiedersich, Westinghouse Electric Corp.

Deformation Stacking Faults in Pb Alloys and Al—G. F. Bolling and T. B. Massalski, Mellon Institute; C. J. McHargue, Oak Ridge National Laboratory.

Short Range Order Strengthening in Cu-Al—T. J. Koppenaal and M. E. Fine, Northwestern University.

THURSDAY, OCT. 20
9 A.M.

REFRACTORY METAL ACTIVITIES IN EUROPE

Refractory Metals Research—R. I. Jaffee, Battelle Memorial Institute.

Sheffield Refractory Metals Meeting—B. S. Lement, Mfg. Laboratories Inc.

AGARD Activities—N. E. Promisel and W. J. Harris, U. S. Navy.

9 A.M.

PLASTIC DEFORMATION—II

Strain Rate Studies of Al-Cu at Low Temperature—J. G. Byrne and M. E. Fine, Northwestern University.

Surface Effects in Crystal Plasticity—J. J. Gilman, General Electric Co.

Cross-Slip and Cross-Climb of Dislocations—J. C. M. Li, U. S. Steel Corp.

Temperature Dependence of Field Processes in Fe—R. Ekvall and N. Brown, University of Pennsylvania.

Recovery of Zone-Melted Fe—J. T. Michalak, U. S. Steel Corp.; H. W. Paxton, Carnegie Institute of Technology.

Mechanical Properties of Dislocation-Free Ge vs. Electronic Properties—J. R. Patel and A. R. Chadhuri, Raytheon Co.

Mobile Dislocations and Dislocation Velocities of Dislocation-Free Ge—A. R. Chadhuri, J. R. Patel and L. G. Rubin, Raytheon Co.

Properties of Tellurium Single Crystals—R. J. Stokes, T. L. Johnson, and C. H. Li, Minneapolis-Honeywell Regulator Co.

Plastic Deformation of InSb—M. A. Abrahams, Radio Corp. of America.

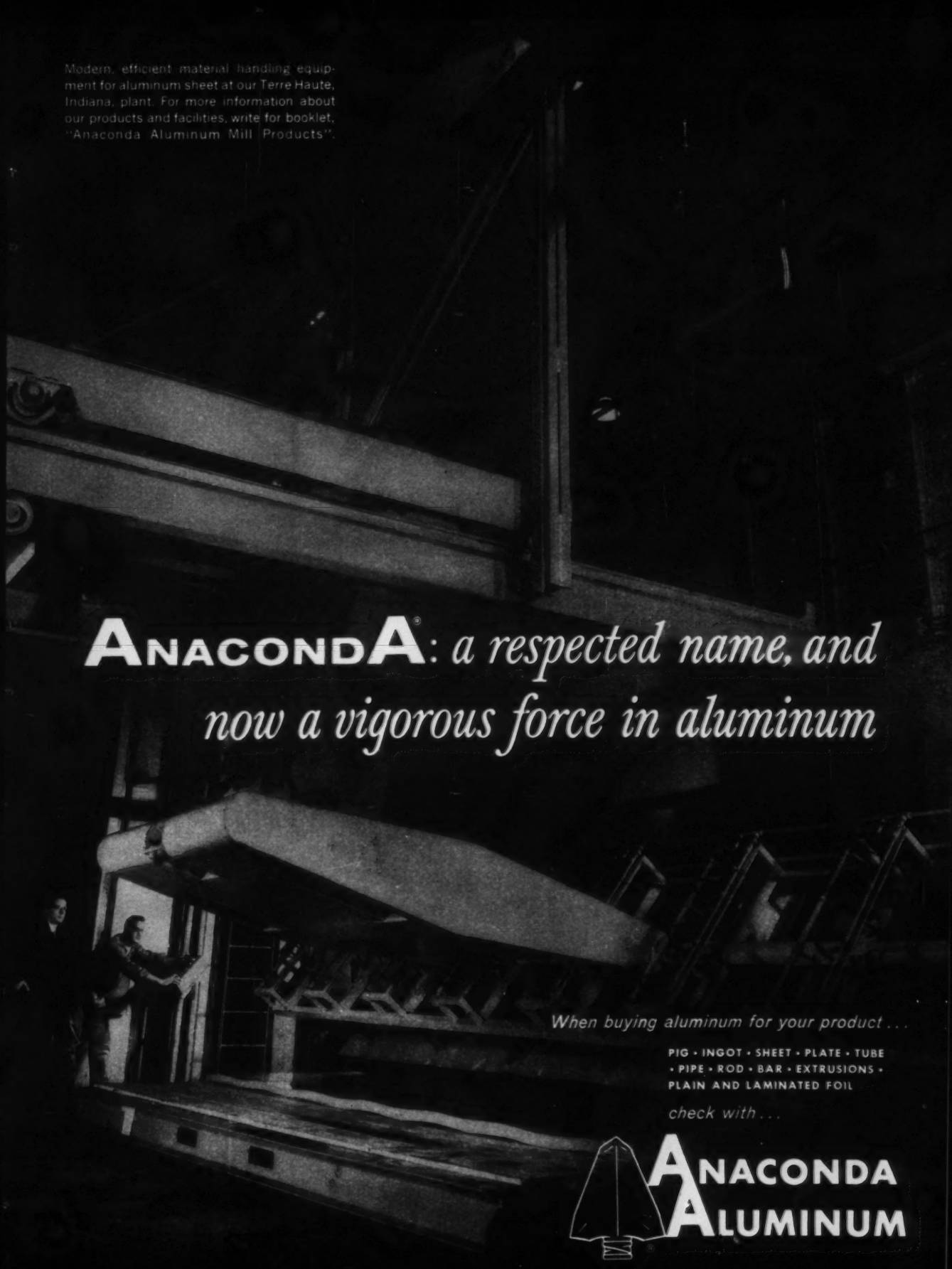
Yield and Fracture Stresses of Si Single Crystals—W. D. Sylwestrowicz, Bell Telephone.

9 A.M.

POWDER METALLURGY—I

Ultrafine Metal Powders—M. Quantinetz, R. J. Schafer, and C. Smeal, National Aeronautics & Space Administration.

(*Please turn to Page* 188)



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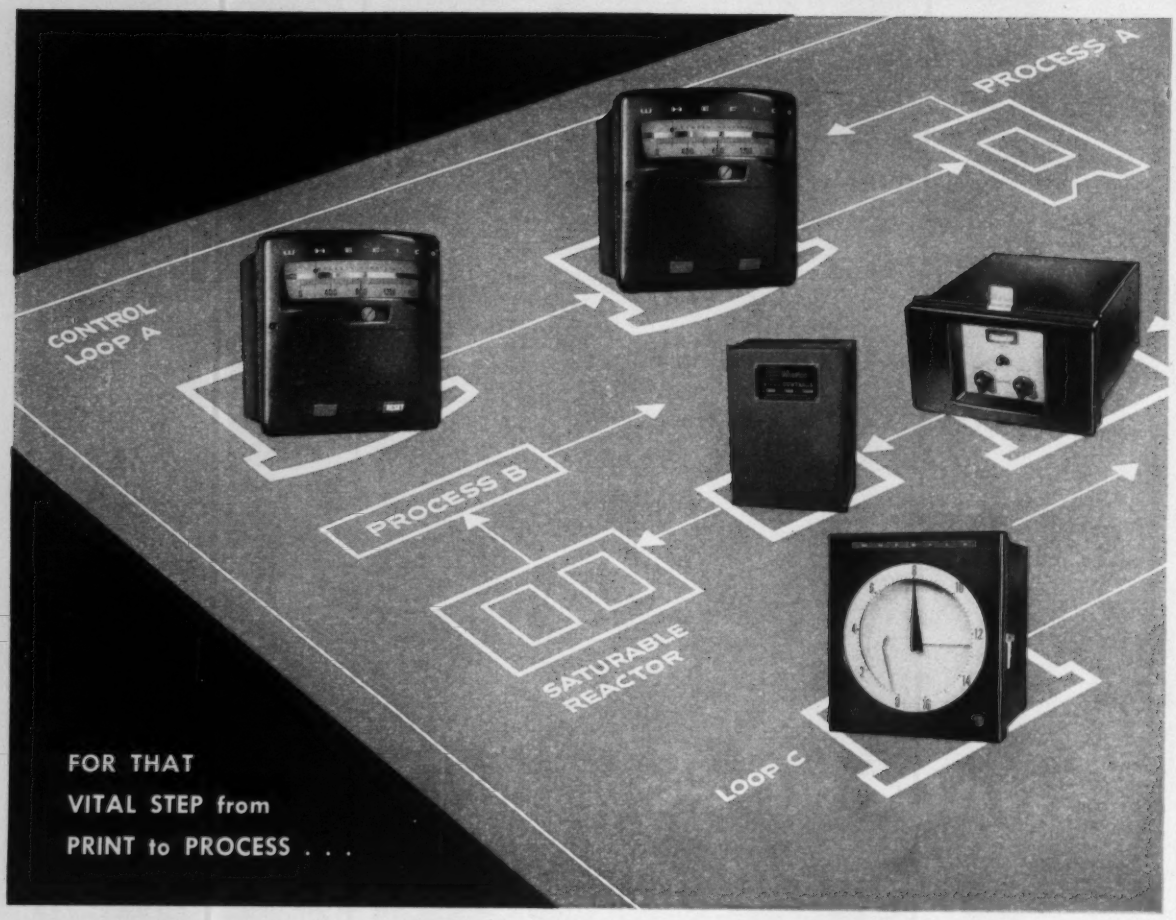

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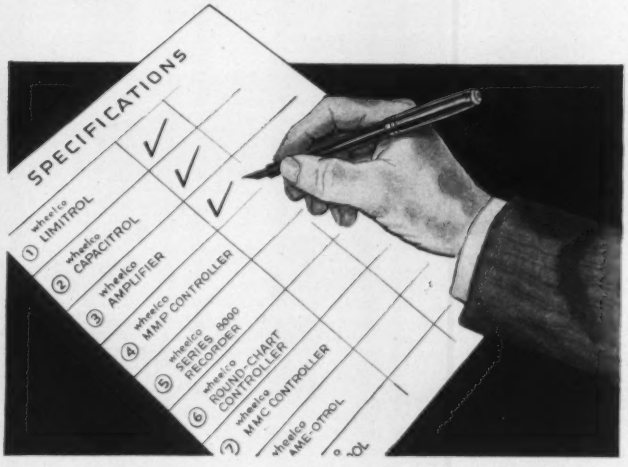

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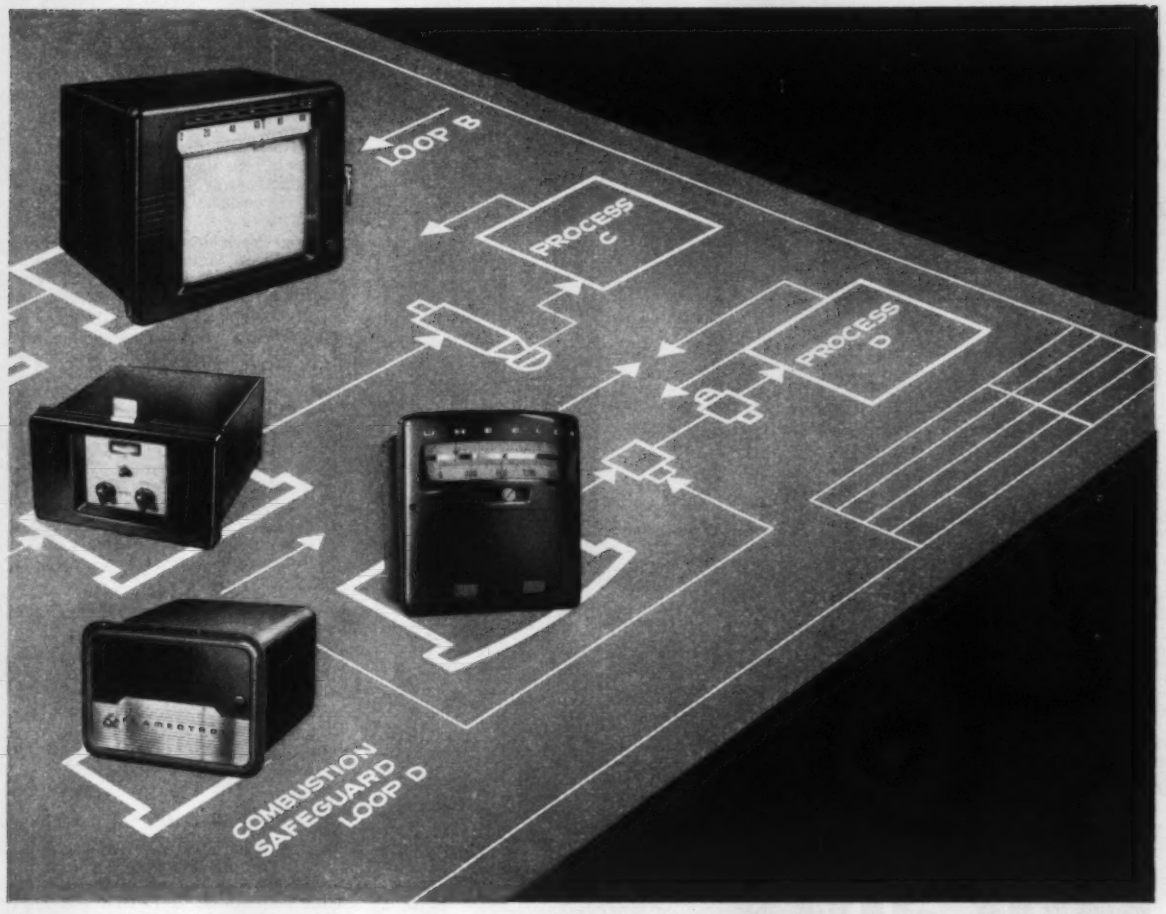

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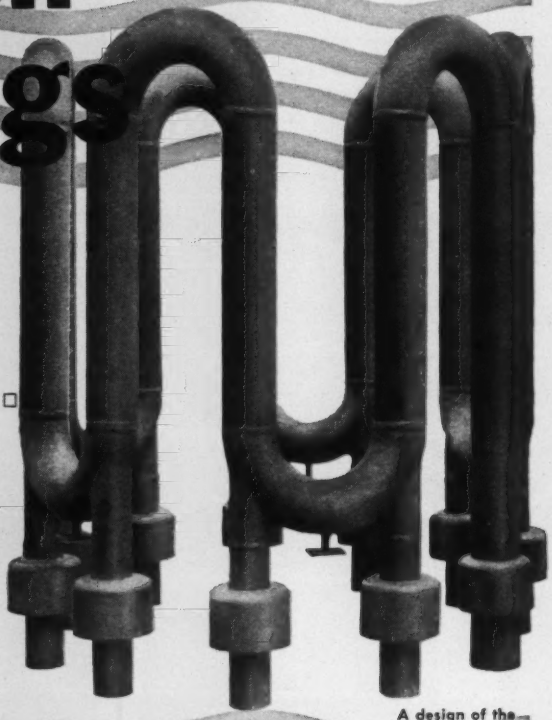

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ASM PROGRAM

(*Continued from Page 184*)

THURSDAY, OCT. 20
9 A.M.

Effect of Particle Size of Ni and MgO Powder Properties—R. J. Schafer, M. Quantinetz, and J. W. Weeton, National Aeronautics & Space Administration.

Processing Variables vs. Properties for Liquid Phase Sintered, High Temperature Alloy—P. A. Clarkin, J. W. Weeton, P. F. Sikora, National Aeronautics & Space Administration.

Pressing Temperature vs. Agglomeration of MgO in Dispersion Strengthened Ni-MgO Alloy—R. J. Schafer, M. Quantinetz, and J. W. Weeton, National Aeronautics & Space Administration.

Refractory Coated Fine Metal Powders—W. B. Tarpley, C. D. McKinney, and W. E. Marceau, Aeroprojects Inc.; G. S. Ansell, Rensselaer Polytechnic Institute.

Metal Bonded Graphite—M. Humenik, R. L. van Alsten, and D. W. Hall, Ford Motor Co.

9 A.M.
ENGINEERING FUNDAMENTALS OF ROLLING PROCESS

Present Status of Theory—L. F. Coffin, General Electric Co.

Boundary Conditions at Roll Material Interface—G. W. Pearsall, Massachusetts Institute of Technology.

Resulting Structure and Properties—W. R. Hibbard, General Electric Co.

9 A.M.
PRECIPITATION AND DISPERSED PHASES

Determination of Number of Particles Per Unit Volume—R. T. DeHoff and F. N. Rhines, University of Florida.

Nucleation Catalysis by C Additions to Mg—V. B. Kurfman, Dow Chemical Co.

Nucleation of Precipitates in Si-Li System—J. W. Ferman and R. A. Swalin, University of Minnesota.

Unidirectionally Solidified Al-$CuAl_2$ Eutectic—R. W. Kraft and D. L. Albright, United Aircraft Corp.

Relationship Between Precipitate and Matrix in Co-Ti Alloys—R. W. Fountain, G. M. Faulring, and W. D. Forgeng, Metals Research Laboratory.

Electrolytic Dispersion Hardening—W. H. Meiklejohn and R. E. Skoda, General Electric Co.

Temperature vs. Yield Behavior of Al-Al_2O_3 Alloys—F. V. Lenel, G. S. Ansell, and R. A. Bosch, Rensselaer Polytechnic Institute.

Precipitation of C from Fe—R. H. Doremus, General Electric Co.

Precipitation of N in Fe Containing Mn—J. F. Enriette, Jones & Laughlin Steel Corp.

Prior Heat Treatment vs. Carbon Strain Aging—J. F. Butler, Jones & Laughlin Steel Corp.

2 P.M.
REFRACTORY METALS

Purification of W by Electron Beam Melting—H. F. Sell, Westinghouse Electric Corp.

Properties of W Alloys Up to 1925° C—E. L. Harmon, Union Carbide Corp.

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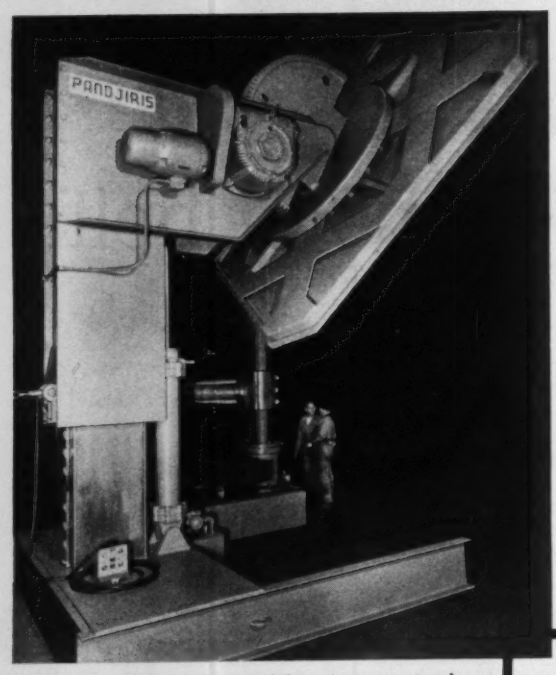

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ASM PROGRAM

THURSDAY, OCT. 20
2 P.M.

Recrystallization of W—E. L. Harmon and W. D. Gorgeng, Union Carbide Corp.

Recovery in W vs. Impurities—R. C. Koo, Westinghouse Electric Corp.

Yield Point in W—R. C. Koo, Westinghouse Electric Corp.

Transition Temperature of W—J. L. Orehotsky, General Telephone Laboratories.

Properties of Cb—A. L. Mincher and W. F. Sheely, Union Carbide Corp.

Oxidation of Cb—W. T. Hicks, E. I. du Pont de Nemours & Co. Inc.

2 P.M.
CREEP, FATIGUE, AND FRACTURE

Creep of Aluminum Oxide Alloy—G. A. Ansell, F. V. Lenel, and J. C. Yen, Rensselaer Polytechnic Institute.

Grain Boundary Sliding in Pb—P. R. Strutt, Franklin Institute.

Surface Energies of Crystals—J. J. Gilman, General Electric Co.

Properties of Al_2O_3 Whiskers—S. S. Brenner, General Electric Co.

Fracture Behavior of MgO—A. R. C. Westwood, Research Institute for Advanced Studies.

Cyclic Leading on MgO—A. J. McEvily, National Acronautics & Space Administration; E. S. Machlin, Columbia University.

Fatigue Cracks in Al Crystals—T. H. Alden, General Electric Co.; W. A. Backofen, Massachusetts Institute of Technology.

Suppression of Cleavage Fracture in Co-Fe Alloy—C. W. Chen, Westinghouse Electric Corp.

Fracturing of Metals Coated With Hg—N. A. Tiner, Douglas Aircraft Co. Inc.

2 P.M.
POWDER METALLURGY—II

Sintering of Oxide Particles Produced by Calcination of Salts—K. Iwase, T. Takada, and T. Hayashi, Kyoto University, Japan.

Early Stages of Sintering—M. Herman, G. E. Spangler, and Henri Amar, Franklin Institute.

Ni Activated Sintering of W Powder—J. H. Brophy, L. A. Shepard, and J. Wulff, Massachusetts Institute of Technology.

Growth of Al_2O_3 in Ni Matrix—F. V. Lenel, J. Dromsky, and G. S. Ansell, Rensselaer Polytechnic Institute.

Shrinkage of Cu Compacts—F. V. Lenel, H. H. Haunser, E. Hayashi, and G. S. Ansell, Rensselaer Polytechnic Institute.

2 P.M.
TEXTURES, RECRYSTALLIZATION, AND RECOVERY

Secondary Recrystallization in High Purity Fe—C. G. Dunn and J. L. Walter, General Electric Co.

Secondary Recrystallization in Si-Iron — T. V. Philip and R. E. Lenhart, Crucible Steel Co. of America.

Growth of Oriented Grains in Si-Iron—J. L. Walter and C. G. Dunn, General Electric Co.

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Bright Annealed Stainless Steel Strip

Conventional steel making is inadequate when you require decorative stainless steel strip with an extra bright finish to pass rigid corrosion tests. "Bright Annealing" is the answer – and Wallingford is the first steel maker to apply this process to its regular production of stainless strip!

How does "Bright Annealing" lower finishing costs? By preventing formation of oxide scales present after conventional annealing and by eliminating the need for further processing which often dulls the finish. Preservation of the bright surface produced by highly polished rolls results in a finish so excellent that users find that buffing time is greatly reduced, affording significant savings.

Superiority in facilities, research and skill enables Wallingford to produce "tonnage on a laboratory basis" and make quality strip available economically.

SEE NEXT PAGE FOR MORE INFORMATION ON BRIGHT ANNEALED STAINLESS STEELS

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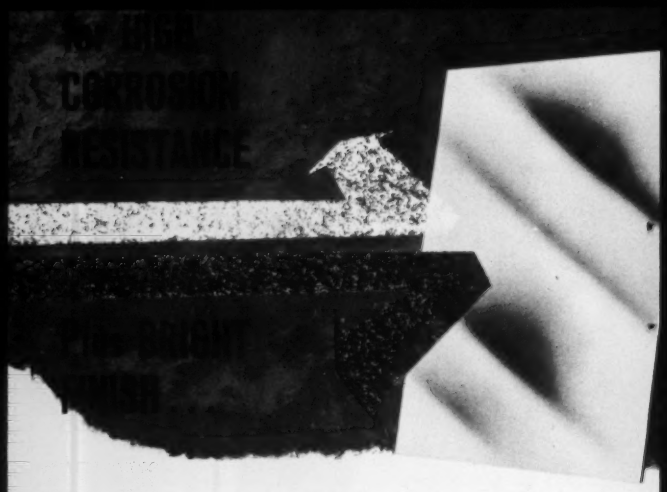

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ASM PROGRAM

THURSDAY, OCT. 20
2 P.M.

Growth Rates of Secondary Grains in Si-Iron—K. Foster, J. J. Kramer, and G. W. Wiener, Westinghouse Electric Corp.

Recrystallization of Fe and Fe-Mn Alloys —W. C. Leslie, F. J. Plecity, and J. T. Mickalak, U. S. Steel Corp.

Recovery of Metals Under Stress—P. H. Thornton, University of Pennsylvania; and R. W. Cahn, University of Birmingham.

Recrystallization Kinetics of a Cold Rolled Crystal—W. R. Hibbard and W. R. Tully, General Electric Co.

Annealing Temperature vs. Preferred Orientation in High Purity Pb—K. T. Aust and J. W. Rutter, General Electric Co.

Annealing Twins in Zone-Refined Al—K. T. Aust, General Electric Co.

Temperature Dependence of Rolling Textures in Ag—H. Hu and R. S. Cline, U. S. Steel Corp.

Evolution of Textures in FCC Metals—Y. C. Liu and R. H. Richman, Ford Motor Co.

Society for Nondestructive Testing

Benjamin Franklin Hotel

MONDAY, OCT. 17
9 A.M.

INSPECTION OF STEEL

Quality of 4130 and 4330 Steel — D. O'Halloran, Northrop Corp.

Specifications for Inspection of Steel—E. T. Grabowski, U. S. Steel Corp.

Differences in Various Metals—J. B. Morgan, Allegheny Ludlum Steel Corp.

Anomalies in Steel Inspection — W. C. Harmon, Republic Steel Corp.

2 P.M.

GENERAL TESTING

Submarine Steel Weldments—N. A. Sinclair and M. Nanda, Electric Boat Div., General Dynamics Corp.

Electron Spin Resonance Spectroscopy—H. A. Elion, Elion Instruments.

Three Dimensional Presentation of Flaws —Col. E. Dugger, WADD, Wright-Patterson Air Force Base; and G. J. Posakony, Automation Instruments.

Bonded Laminates—R. O. Huffstetler, Bell Helicopter Corp.

TUESDAY, OCT. 18
9 A.M.

TESTING AND QUALITY CONTROL

Practical Quality Control—E. R. Ott, Rutgers University.

Electronics—A. W. Wortham, Texas Instruments Inc.

Reliability and Quality Control—B. J. Cunningham, Minneapolis - Honeywell Regulator Co.

WEDNESDAY, OCT. 19
9 A.M.

ELECTRONICS INDUSTRY

Philosophy of Testing—R. C. McMaster, Ohio State University.

This Pannier Offset Bar and Tube Printer at the Superior Tube Company, Norristown, Pennsylvania, is shown marking tubing. The tubing moves from the marker right to a delivery table, ready to bundle for shipment.

MARK BARS, EXTRUSIONS AND TUBING QUICKLY, CLEARLY FOR EASY IDENTIFICATION

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Top surface printing permits constant inspection. Fast drying inks permit immediate handling. The standard offset printer is right-hand feed; left-hand feed is available to fit your conveyor line system without disrupting present line movements.

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The Pannier Offset Bar and Tube Printer is available with a ¾ horsepower variable speed motor, or is friction driven from your existing conveyor for continuous flow materials. The power unit has a magnetic starter that activates motor as material passes through the limit switch. This eliminates excessive ink build-up on the offset printing wheel, and assures clean, clear marking.

Pannier also has a small model Offset Wire Bar and Tube Printer, which is recommended for printing materials less than 4″ O.D. Pannier engineers will be glad to consult with you on all your marking problems. For complete information, write:

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ASM PROGRAM

WEDNESDAY, OCT. 19
9 A.M.

Mechanisms of Failure—L. L. Schneider, Reliability Engineers Associates.
Component Screening — R. E. Thomas, Battelle Memorial Institute.
Destructive vs. Nondestructive — D. D. Seltzer, Martin Co.

9 A.M.
POWER AND NUCLEAR PLANTS

New Equipment in Plants—J. Klapper, Ebasco Services Inc.
Piping and Equipment in Nuclear Plants—E. C. Miller, Oak Ridge National Laboratory.
Service Failures—H. Thielsch, Grinnell Co.

2 P.M.
APPLICATIONS OF TESTING IN ELECTRONICS

Infrared Applications — J. H. Beardsley, Perkin-Elmer Corp.
Basic Components—Speaker to be announced.
Component Manufacturing—A. J. Heitner, Sylvania Electric Products Inc.
Subsystem and System Levels—P. S. Dick, General Electric Co.

2 P.M.
GAS TRANSMISSION PLANTS AND PIPING

Program to Be Announced.

THURSDAY, OCT. 20
9 A.M.
GENERAL TESTING

Photostress—F. Zandman, Budd Instruments.
Automatic Magnetic Particle Inspection—H. E. Farmer, General Electric Co.
Experimental Stress Analysis—J. G. Locklin and F. C. Fleck, General Motors Corp.
Density Ratio Method—Radiographs—R. J. Mascis, Aerojet-General Corp.

2 P.M.
QUALITY ASSURANCE IN THE FIELD

Neutron Activation Analysis—S. Regas, Radiation Counter Laboratories.
Hardened Concrete—C. M. Shilstone, Shilstone Testing Laboratories.
Moisture and Density Measurement in Soils—J. E. Templeman, Nuclear-Chicago Corp.
Blacklight Inspection—R. K. Cornell, Black Light Products Co.

FRIDAY, OCT. 21
9 A.M.
EDUCATIONAL CLINIC

Scope—D. W. Ballard, Sandia Corp.
Radiography—W. D. Kiehle, Eastman Kodak Co.
Fluoroscopy—W. R. Hampe, Westinghouse Electric Corp.
Magnetic Particle—R. F. Strother, Magnaflux Corp.

2 P.M.
EDUCATIONAL CLINIC

Penetrant Inspection—H. Migel, Magnaflux Corp.
Eddy Current—R. Hochschild, Budd Co.
Ultrasonic Theory—H. Smolen, Frankford Arsenal.
Ultrasonic Applications—W. C. Hitt, Automation Instruments.

Metal Powder Industries Federation

Bellevue-Stratford Hotel

WEDNESDAY, OCT. 19
2 P.M.

Sintered Brass—V. Tarr, Midwest Sintered Products Corp.
Ceramic Molds—D. W. A. Forbes, Hamilton Porcelains Ltd.
Thin Walled Cones—R. Powell and L. Zalesk, Frankford Arsenal.
Iron Powder by Fluidized Bed Method—A. B. Backensto, Alan Wood Steel Co.

Metal Treating Institute

Bellevue-Stratford Hotel

THURSDAY, OCT. 20
9 A.M.

Heat Treating Components for Space Age Products—Panel discussion.
Vacuum Heat Treating—R. Krogh, Ipsen Laboratories.
Heat Treating Specifications—J. Benedict, Benedict-Miller Co.

Ultrasonic Manufacturers Assn.

Bellevue-Stratford Hotel

THURSDAY, OCT. 20
2 P.M.
ULTRASONICS

Dissimilar Metal Joining by Ultrasonics—R. S. Ames, Aeroprojects Inc.
Developments in Ultrasonic Equipment—M. Damast, Narda Ultrasonics Corp.
New Applications—A. Valente, Westinghouse Electric Corp.
Cleaning Shotblasted Strip—H. Osterman, Branson Ultrasonic Corp.

Special Libraries Association

John Bartram Hotel

THURSDAY, OCT. 20
2 P.M.
SYMPOSIUM: JOINING METALS

Fundamentals of Inert Gas Shielded, Consumable Electrode Process—I. D. Holster, Air Reduction Co. Inc.
Inert Gas Tungsten Welding In Aircraft and Missiles—H. S. Davis, Air Reduction Co. Inc.
Silver Brazing—D. C. Herrschaft, Handy & Harman.

FRIDAY, OCT. 21
9 A.M. & 2 P.M.

First and Second Sessions of ASM Metals Engineering Institute Metallurgy Course—Fundamentals Concepts of Metallurgy.

SATURDAY, OCT. 22
9 A.M. & 2 P.M.

Third and Fourth Sessions of ASM-MEI Metallurgy Course—Advancing Frontiers in Metallurgy.

Find the "other man"!

Find the "other man" and you'll find another reason why you should come to Carlson for your stainless steel plate and other stainless products. The "other man" is an unseen crane operator. He, together with the hook-up man directing the loading of a stainless head in our shipping bay, is working "after hours" for one purpose—to assemble and ship a customer's order *fast*.

Why? The customer's production schedule may have changed suddenly. Perhaps quick delivery is needed to repair a vital piece of equipment. Whatever the reason, the customer knows he can count on Carlson for exceptional service. For Carlson is accustomed to producing and delivering, *fast*, a wide variety of high quality stainless steel products.

Specialized Carlson service is as near to you as your phone. Call or write for prompt action. The phone number: DUdley 4-2800.

G.O.CARLSON *Inc.*

Producers of Stainless Steel

122 Marshallton Road
THORNDALE, PENNSYLVANIA
District Sales Offices in Principal Cities

PLATES • PLATE PRODUCTS • HEADS • RINGS • CIRCLES • FLANGES • FORGINGS • BARS AND SHEETS (No. 1 Finish)

SHOPPING CENTER FOR 150 MILLION

People to buy your products — people to make them. One hundred fifty million people, 75% of the total population of the U.S. and Canada, live within 500 miles of Ohio.

Reaching them is quick and inexpensive. Ohio boasts 2 seacoasts — the Ohio River and the St. Lawrence Seaway — an unmatched system of interstate highways, rail and plane transportation.

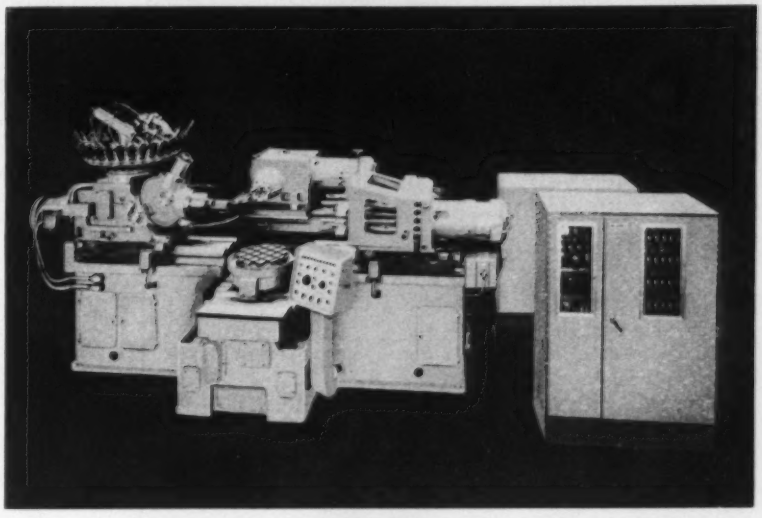
Plentiful power, vast supplies of raw materials, an encouraging tax structure complete the profit picture for your products or services. Build your next plant in the State of Ohio. Ask us for plant sites and factual information.

Koder M. Collison, Director

STATE OF OHIO DEPARTMENT OF INDUSTRIAL AND ECONOMIC DEVELOPMENT

700 Bryden Road, Columbus 15, Ohio

Tape Controlled Unit Speeds Batch Lot Machining



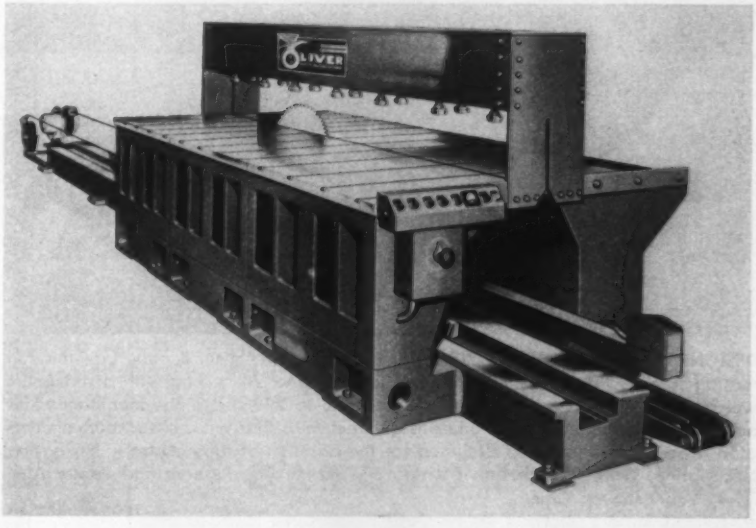
THE MT-3 machining center is a versatile unit that can handle a large variety of parts in sizes to 12 x 12 x 12 in. The company says the tool brings production line efficiency to batch lot production of parts requiring face and other milling cuts plus drilling, boring, reaming, and tapping operations. Quantities from 5 to 500 are well suited for the unit.

Savings claimed: 1. Reduction of tooling cost by eliminating drill fixture requirements and reduction of the number and complexity of mill fixtures required. 2. Reduction in nonproductive machine time by providing automatic tool change and eliminating the requirement for manually reorienting fixture and part for each successive operation on a number of conventional machines. 3. Optimization of the machining process by providing for cutter selection, feeds, and speeds to be made on an engineering level and controlled by tape.

The three station machine uses the building block principle and has independent spindle drive motors (each with 5 to 7½ hp capacity). The central positioning table is surrounded by three tape controlled work heads: 1. A universal drilling, tapping, and boring head with a storage capacity for 30 tools (tool change takes less than 3 seconds). 2. A face milling head. 3. A multiple spindle drill head or a precision boring head with a 14 tool capacity changer. The tool may be purchased without the third head.

For further information, *write* Industrial Systems Div., Hughes Aircraft Co., P. O. Box 90904, Airport Station, Los Angeles 45, Calif.

Plate Saw Handles Ferrous and Nonferrous Metals



STEEL plates and other ferrous and nonferrous metals can be cut on a production basis on the Oliver No. 849, heavy duty, plate saw.

The carriage (about 6½ ft long) rides on nonmetallic ways 5 in. wide on one side and 6 in. wide on the other. Total bearing surface exceeds 600 sq in. Carriage feed is through a Reliance drive to a reduction unit with a helical gear on the output-shaft fitted to a helical rack (in the center of the cast iron bed).

Accurate feed settings can be determined by setting and marking the rheostat control from the operator's position. Rapid return of the carriage is about 300 in. a minute.

The machine is designed to cut steel plates 3 in. thick, 8 ft. long. A

similar machine has cut 1¾ in. thick steel plates (12 ft long) at a rate of 19 lineal in. a minute. That was a continual operation, sawing a plate 6 x 12 ft into bars 5½ in. wide. Time: 7 minutes per 12 ft cut.

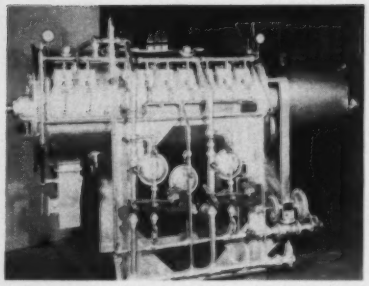
The company says SAE 1020 steel 3 in. thick has been cut at the rate of 19 in. per minute.

See the saw at the Metal Show (Booth 1355) or *write* Oliver Machinery Co., Grand Rapids, Mich.

Furnace, Quenching Tank Keep Parts in Motion

PARTS are kept in motion during heating and quenching in the Automotion furnace and quenching tank. Motion in the furnace retort helps assure each part receiving the same heat and exposure to the atmosphere. In the rotary quenching drum, part motion provides a superior quenching action for maximum, uniform hardness.

A built-in continuous feeder helps eliminate labor in feeding parts. The furnace and quenching tank use a spiral (an integral part of the furnace retort and quenching drum) to convey the work through heat and quench. Conveyors and other similar devices are not used. Model 136-MGE has a production heat treating capacity of about 250 lb an hour.



See it at the Metal Show (Booth 1910B) or *write* American Gas Furnace Co., Elizabeth B, N. J.

Metal Cleaners Handle Production Line Jobs

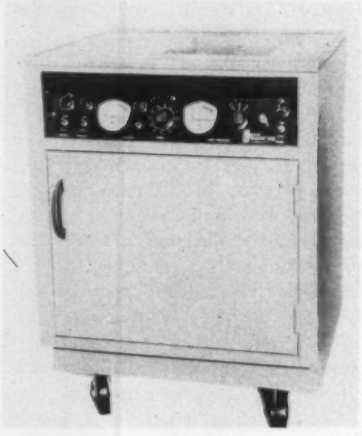
FOUR production line cleaners developed by Houghton are designed to meet the requirements of the four basic cleaning processes, including hot and cold power washers and soak tanks. The series is called Cerfa-Kleen.

See them at the Metal Show (Booth 709) or *write* E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Ultrasonic Cleaner Mounted on Casters

A SELF-CONTAINED ultrasonic cleaner made by National Ultrasonic Corp. is caster mounted. The cleaner is drained by a flexible hose attachment.

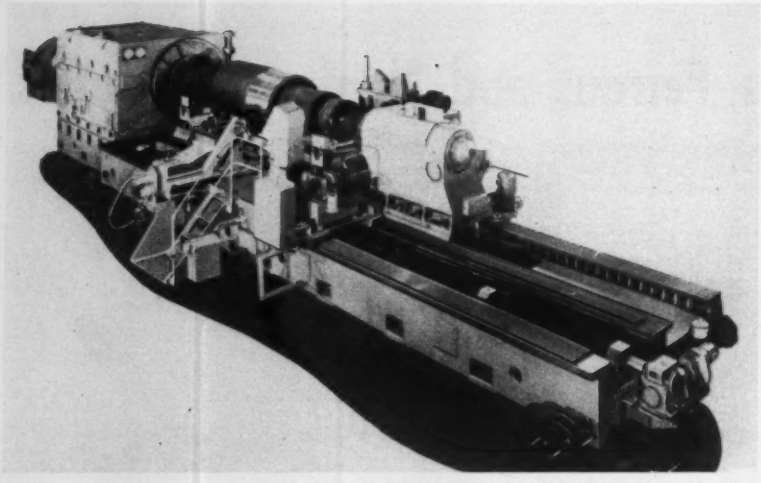
Tanks are positioned off-center to provide a work area. The unit can be used with solvents, detergents, mild acids, and alkaline cleaners. The tank and countertops are stainless steel



Heavy gage steel is used in the cabinet construction.

Optional equipment includes a 2-5 micron filter and heating elements to maintain liquid temperature from ambient to 160° F. The unit requires a 115 volt power supply.

See it at the Metal Show or *write* National Ultrasonic Corp., 111 Montgomery Ave., Irvington, N. J.

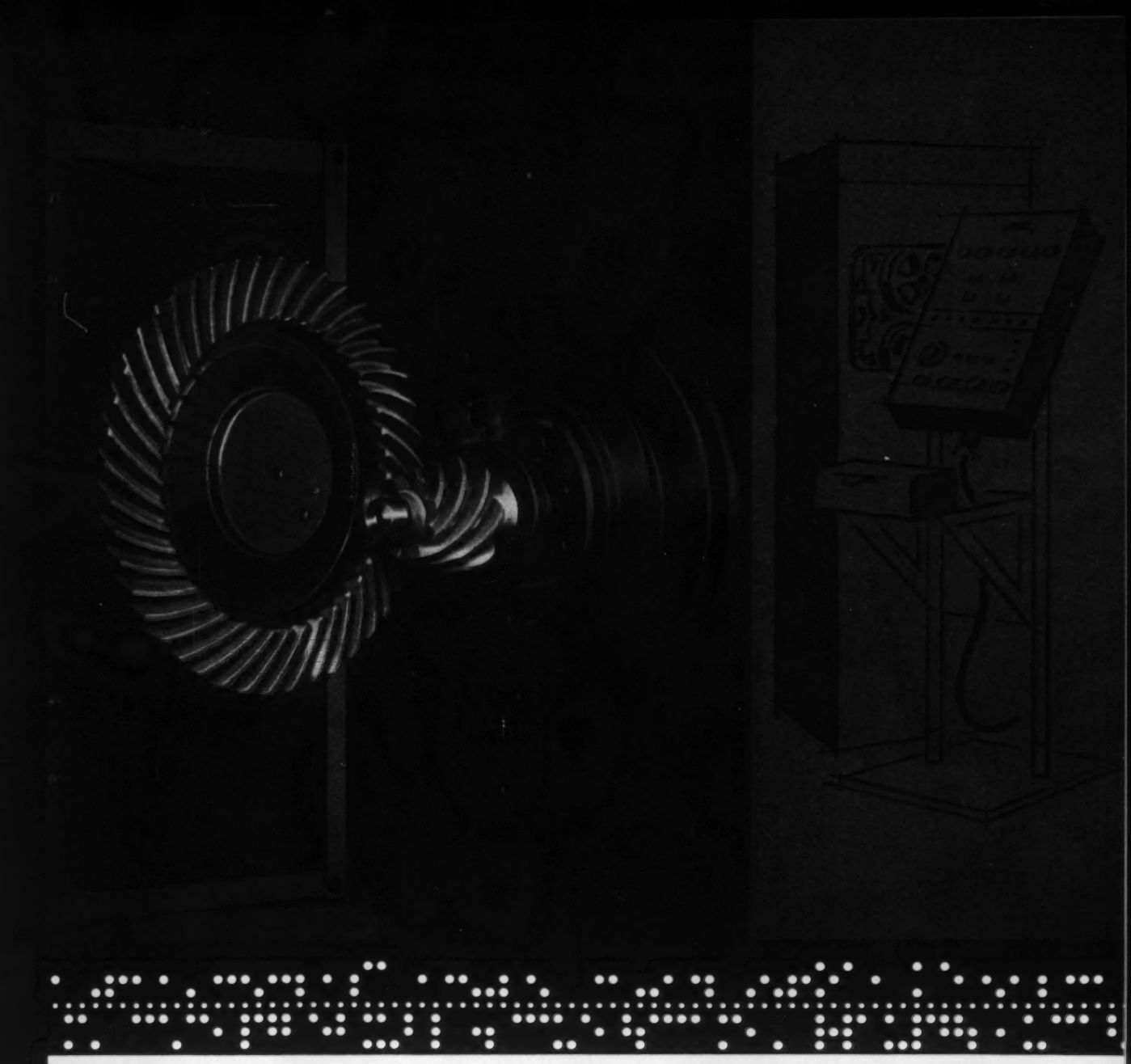


DESIGNED FOR 79 IN. HOT STRIP MILL at Youngstown Sheet & Tube Co., this roll turning lathe swings rolls 70½ in. in diameter and 24 ft long with a maximum weight of 140 tons on centers at speeds of 1.3 to 228 rpm. The manufacturer is building a similar unit (for another large steel mill) that will be pushbutton operated, tracer controlled, and designed for the addition of tape control. For further information, **write** Youngstown Foundry & Machine Co., Reserve and Parker Avenues, Youngstown, Ohio

Cold Walls Designed Into Vacuum Furnace

WATER and power connections are the only installation requirements of the Hayes console vacuum furnace. Maximum operating furnace temperature of the standard unit is 2200° F with the vacuum rated in the 10^{-4} mm Hg range.

The furnace can reach maximum temperature in a few minutes. The stainless steel, vacuum chamber (10



Gleason Works announces automatic gear tester operation through tape control

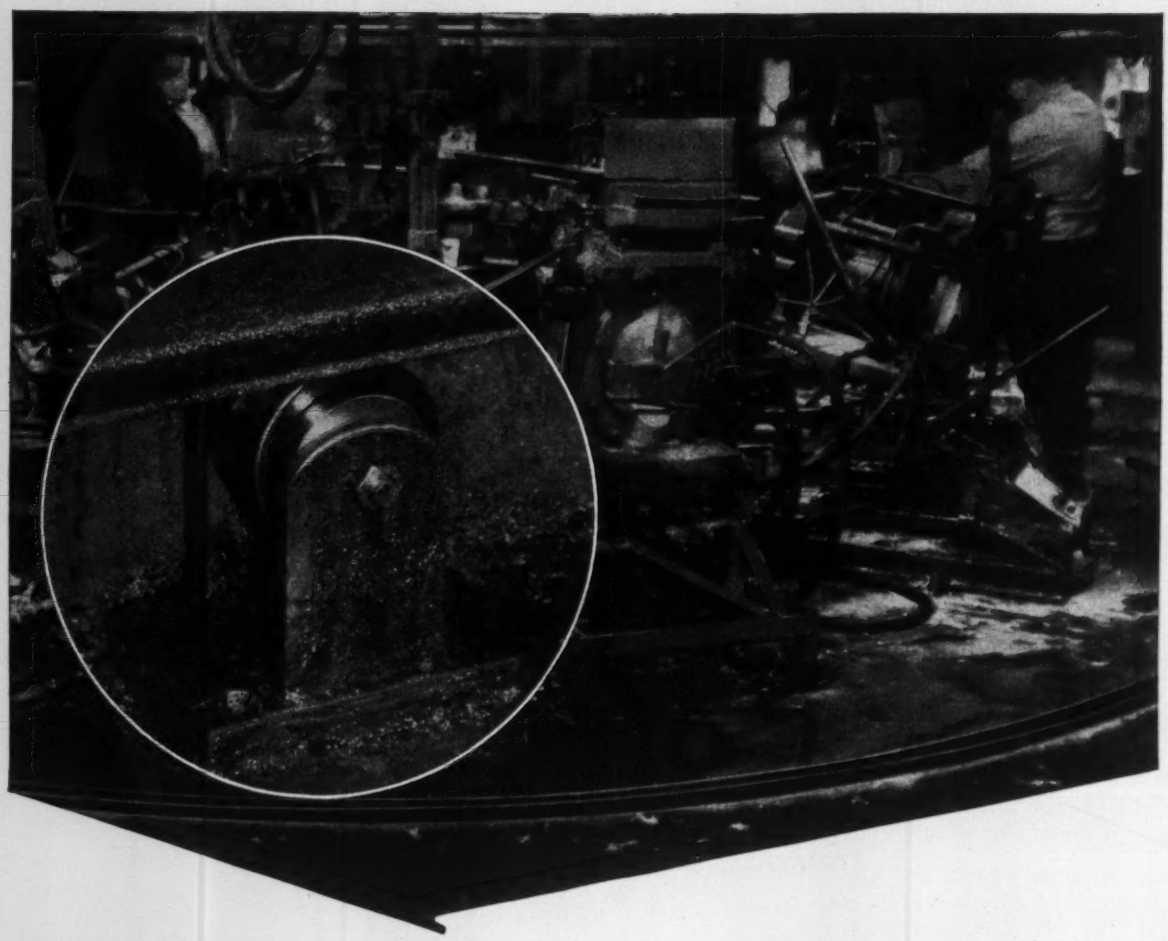
Electronic tape control on Gleason Production Testers will make your bevel and hypoid gear tester operation an automatic process. Tape controls will allow you to automatically pre-set and vary test factors—direction of rotation, tooth bearing position, pinion spindle speed and brake load—in any sequence you wish.

Once you tape the test sequence, you can repeat it exactly anytime—for the next pair of gears or repeat the set-up months later.

Write us. We will be pleased to send additional information.

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.



Bearings, Inc. turned this turntable from a costly maintenance problem into a smooth, trouble-free operation!

Our customer, an aluminum foundry, designed and built this system for continuous and automatic pouring of permanent mold castings. The turntable is approximately 20 feet in diameter. Supporting the table, which weighs several tons, were 20 large, double-row bearings. The life of these bearings was only a few weeks and their cost, plus downtime, was becoming increasingly expensive.

Our bearing engineers were asked for a solution and, after an investigation, recommended a camroll bearing. Now, after many months of operation, all turntables in the plant are equipped with the bearings we recommended and there has not been a bearing failure in that period!

If you have a problem involving bearings, call the Bearings, Inc. branch nearest you for expert help. We are the authorized distributor for all the bearings we sell —your guarantee that the bearings we deliver will be of the latest manufacture and right for your application!

Providing bearing service in the North → **BEARINGS, INC.**

DELAWARE: Wilmington • **ILLINOIS:** Neiman Bearings Co., E. St. Louis • **INDIANA:** Ft. Wayne • Indianapolis • Muncie Terre Haute • **MARYLAND:** Baltimore • **MISSOURI:** Neiman Bearings Co., St. Louis • **NEW JERSEY:** Camden • Newark **NEW YORK:** Balanrol Corp., Buffalo • Niagara Falls • **OHIO:** Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton Lima • Lockland • Mansfield • Painesville • Toledo • Youngstown • Zanesville • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York **WEST VIRGINIA:** Charleston • Huntington • Parkersburg • Wheeling

and

in the South → **DIXIE BEARINGS, INC.**

ARKANSAS: Little Rock • **FLORIDA:** Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge New Orleans • **N. CAROLINA:** Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville Memphis • Nashville • **VIRGINIA:** Norfolk • Richmond • Roanoke

in. in diameter and 20 in. deep) has a useful work area of 8 x 14 in. The access door and all control equipment are on the front panel with access panels on the sides and back for servicing. Potassium titanate insulation helps reduce heat losses and radiation shield requirements. Cold wall design helps protect auxiliary equipment, instrumentation, and the surrounding work area from objectionable heating.

See the furnace at the Metal Show (Booth 1454) or *write* C. I. Hayes Inc., 822 Wellington Ave., Cranston, R. I.

Gas Generating, Control Equipment Developed

A CARBON potential controller, reversible endothermic gas generators, and ammonia dissociators have been announced by Rolock Inc.

Developed to maintain control over the carbon potential for the gaseous atmosphere in heat treating furnaces, the controller continuously senses the temperature-carbon relationship in a small burning sample of the furnace gas. The sensing element (through a recording controller and servos) corrects the atmosphere. Dew point is not used as the control basis.

The generators provide a controllable endothermic furnace atmosphere gas supply using propane, manufactured, or natural gas. A reversible dual catalyst chamber system is used. The catalyst beds can be cleaned by simple reversal and without shutdown.

See the units at the Metal Show (Booth 1809) or *write* Rolock Inc., Fairfield, Conn.

Hourly Furnace Capacity: 50 to 1200 lb an Hour

THE Sunbeam shuffle hearth furnace is designed for automatic, continuous controlled atmosphere heat treating and quenching. It can be used for hardening and carbonitriding within a range of 1400 to 1800° F.

The company says it's adaptable to processing small parts such as

(*Please turn to Page* 204)

NEW MASSIVE MC NYLON PLATE NOW AVAILABLE!

• Huge MC Nylon plate—the largest ever produced—is now available for wear plates, panels, tooling, fixtures and other applications which need nylon's unique mechanical or structural properties.

Polymer's exclusive revolutionary new processing techniques make production of large plate practical with price reductions of 15% under nylon plate presently available. Standard stock availabilities now include thicknesses from ½" up to 4" and in 2' by 4' sections. Availabilities to date were limited to 1½" maximum thickness in 10" widths. MC Nylon now opens new design possibilities and manufacturing economies. On special order plates of over 6" thickness in sections of 4 foot widths and 10 foot lengths can be supplied.

In tubular bars, the specially formulated bearing material now costs less than continuous cast bronze bushings of similar size, with prices up to 50% below other nylons.

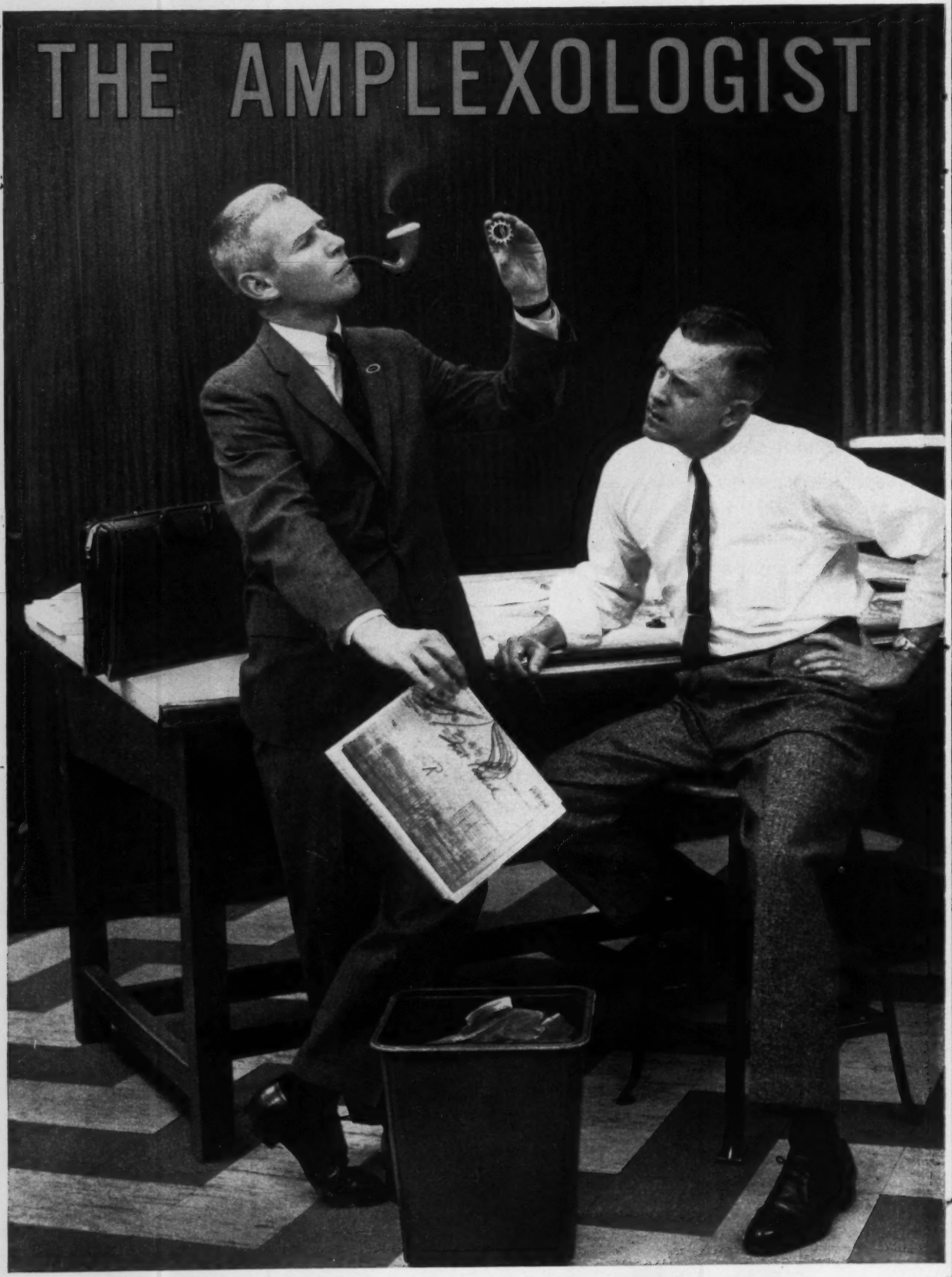
MC Nylon tubular bars are made in OD's from 2" to 15" with wall thicknesses of ⅜", ½", ¾" and 1". Rod up to 17" diameter is also available with special larger sizes and shapes made to order. Supplied in Polypenco blue.

Call or write for full information.

POLYPENCO® *industrial plastics*

The Polymer Corporation of Pennsylvania
Reading, Pa.
Export Polypenco, Inc., Reading, Pa., U.S.A.

THE AMPLEXOLOGIST



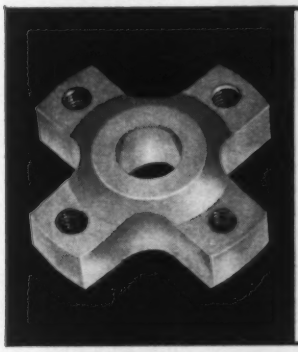
The Amplexologist has a high regard for prospective customers' blueprints. He finds it necessary upon occasion, however, to put them respectfully aside. Especially when he's told: "We tried to make this part out of powder metal a couple of years ago but the supplier couldn't meet our specs."

The Amplexologist, you see, has heard this song before. That's why he puts down the prints and picks up the part. And starts probing.

What does this part have to do? Under what conditions? Any special strains? Impact? Where? What about the configuration? Is this contour functional? Are these sharp angles necessary?

Often as not, the answers to these questions hit pay dirt. They usually reveal, in fact, that with a little redesigning another "impossible" part can, after all, be made better and cheaper through advanced powder metallurgy (i.e. Amplexology).

We're happy to say that most manufacturers are eager to eat their own specifications anytime they can save thousands of dollars and still maintain (or improve) quality. Their willing appetite has helped make us the world's largest and most experienced producer of powder metal parts. One more reason why manufacturers say, **When it comes to powder metallurgy—Amplex has the answer.**



A LITTLE RE-DESIGNING . . .

The part shown is an engine fan-pulley hub. It was formerly a solid circular casting. The manufacturer had to machine the face, bore the ID, drill and tap four holes. The Amplexologist re-designed the hub into its present cloverleaf shape—to reduce weight and cost of material. It is now being produced by powder metallurgy as a finished precision part that requires no machining—except tapping the holes. Total savings about 33%.

AMPLEXOLOGIST

SEND COUPON . . . if you'd like to talk over your product with the Amplexologist. Don't hesitate. He's always happy to get out of the office.

AMPLEX DIVISION • CHRYSLER CORP. • Dept. S10
P.O. Box 2718 • DETROIT 31, MICH.

Please have the Amplexologist call to look into the possibility of using powder metal parts in our product.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

PRODUCT_____

AMPLEX

DIVISION CHRYSLER CORP.

A CHRYSLER OILITE® PRODUCT

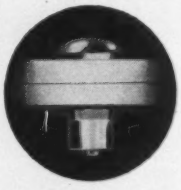
Townsend Lockbolts now available in Stainless Steel for greater strength ...corrosion resistance

If you need extra strength in fastening your assembly—plus corrosion resistance—you can get both now with Townsend 18-8 stainless steel lockbolts.

The use of Townsend stainless lockbolts gives you greater flexibility of design and the values are highly uniform. There is no chance for human error in setting lockbolts. Men with no special training get strong, vibration-proof joints every time.

Townsend stainless lockbolts are vastly easier to install—for example, they eliminate the back breaking work of bucking stainless rivets which work-harden rapidly.

Townsend lockbolts are also available in carbon steel and aluminum alloy in a wide range of diameters and grip lengths in brazier, button and 90° countersunk head styles. Write today for information to Engineered Fasteners Division, P.O. Box 71-C, Ellwood City, Pennsylvania.



Licensed under Huck patents RE 22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

Townsend Company

ESTABLISHED 1816

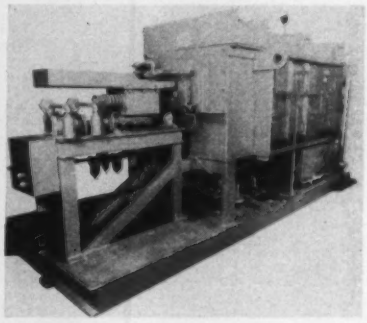
Engineered Fasteners Division

ELLWOOD CITY • PENNSYLVANIA

Cherry Rivet Division • Santa Ana, California

NEW PRODUCTS and equipment

(*Continued from Page 201*)



fasteners. It can be built in a range of sizes that can process 50 to 1200 lb an hour.

See the furnace at the Metal Show (Booth 1710) or *write* Sunbeam Equipment Corp., Meadville, Pa.

Electrostatic Gun Sprays Water Base Paints

CONDUCTIVE, water base, and a wide range of standard paints (without special formulation) can be sprayed by the Model 10, centrifugal, electrostatic spray gun.

The unit can be used indoors or outdoors. The hand guns are sold outright.

See it at the Metal Show (Booth 1972) or *write* Ionic Electrostatic Corp., 111 Monroe St., Garfield, N. J.

Nondestructive Test Equipment Improved

NONDESTRUCTIVE testing systems and equipment developed by Magnaflux include formulations for visible and fluorescent magnetic particle testing; a portable ultrasonic thickness measuring instrument; and a 3000 ampere, mobile, Magnaflux unit with infinite current control.

The materials for particle testing are in convenient powder form (they can be mixed, handled, and stored easily). Other features: Increased fluorescent brilliance; closely controlled particle size range; less foaming, and increased corrosion protection.

Chassis, sensitivity, and readout in the battery powered unit for meas-

from RCA...

3 NEW Electronic Systems that Advance Industrial Automation

RCA Industrial Electronic Control is industrial dynamism of a higher order—a new electronic control of production operations resulting in a smoother flow through the plant, a bigger yield, and a degree of efficiency never before attainable.

Systems capabilities range from simple automatic monitoring to complete real-time control of a complex automated operation spread over a wide area. There are *now* three RCA Industrial Electronic Control Systems available:

The RCA-110 Industrial Control Computer System—Specifically designed for industrial applications to provide around-the-clock operating reliability, highest arithmetical speed and lowest cost installation. Solid state design, core and random access drum memory. Computer built for industrial environment.

The RCA-130 Industrial Data Transmission Link—Removes the limitation of distance in an automatic monitoring or control system. Provides reliable on-line, real-time transmission of analog or digital information via wire or radio, one-way or two-way. 100% checked.

The RCA-150 Industrial Data Analysis and Recording System—Provides high-speed, automatic monitoring and analysis of process and production status—plus computational capability for summarizing, averaging, totalizing and linearizing.

These new RCA systems incorporate industrial thinking as advanced as the electronic design of the equipment itself. The new concepts may well be of paramount importance to the future of your business. RCA Industrial Electronic Control Systems are available with Foxboro and other instrumentation.

For special industrial control problems, **Custom Systems** can be supplied to fit your exact needs.

To tell you how this modern kind of industrial automation works and the many things it will do, would fill a book. You will want to get the full story in person. Ask your nearest Foxboro representative or write—Industrial Computer Systems Department, Electronic Data Processing Division, Radio Corporation of America, 21 Strathmore Road, Natick, Mass.

AUTOMATIC PROCESSING

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

uring thickness have been improved. Accuracy is better than ± 1 per cent (check against a known sample).

The 3000 ampere, mobile, Magnaflux unit (model KSH-3D) is housed in a stable chassis. It's equipped with a J.I.C. subpanel, latch type, disconnect switch; two, 110 volt outlets; new type rectifiers; and remote demagnetization.

See the units at the Metal Show (Booth 1520) or *write* Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.

Testing Units Simulate Heat and High Altitude

TEMPERATURES from −180° to 250° F and altitudes to 200,000 ft can be simulated in a bench type unit. Light and portable, it has a 14 x 14 x 14 in. chamber.

Accessories include terminals, ports, and programing instrumentation. Shipping weight: about 450 lb.

See it at the Metal Show (Booth 1959) or *write* Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio.

Drive Systems Provide Power at Several Points

A DRIVE system (Bulletin 111 Syncro-Range) provides adjustable speed of synchronous induction motors running in exact synchronism over a wide speed range. Size range: 2 to 15 hp.

The drive is an integrated system with an adjustable frequency power supply, one or more Syncro-Spede drive motors, and a control panel. Typical applications include continuous process machines which require power at a number of points on the machine.

For further information, *write* Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.

Introduces Alloys to Boost Stainless Melt Qualities

VANADIUM Corp. of America is now offering Thermocol (exothermic ferrocolumbium) and special ferrochrome-silicon alloys for stainless steel production. The company says both materials offer improved performance and efficiency of the melt.

See the products at the Metal Show (Booth 204) or *write* Vanadium Corp. of America, 430 Lexington Ave., New York, N. Y.

Rockwell Readings Can Be Taken Up to 1800° F

TWO hardness testers have been developed by Wilson Mechanical Instrument Div., American Chain & Cable Co. Inc.

One model tests hardness (Rockwell or Rockwell superficial) at temperatures up to 1800° F. It comes with a water cooled, induction furnace that can be indexed by handwheels to make a series of indentations on the specimen. You can control the temperature automatically or manually. Specimens up to 2 in. in diameter and 4 in. long can be tested. It has a transformer and

FIELD TESTED, PROVED FOR OVER 1 YEAR

Plibrico "80"

80% ALUMINA PLASTIC

Offers ease of plastic installation... plus all advantages of high alumina content

Service temperatures to 3200° • Non-wetting to most metals • High abrasion resistance

Here are the proven facts about Plibrico "80" revealed by well over a year of actual on-the-job service.
Plibrico "80" provides a joint-free monolithic lining of high density . . . a lining that's non-wetting to aluminum, steel and brass . . . a lining that shows very good resistance to abrasion and excellent resistance to acid. Valuable features, all aimed at reduced maintenance costs. And what's more, Plibrico "80" is easy to work and install, requires no forms.

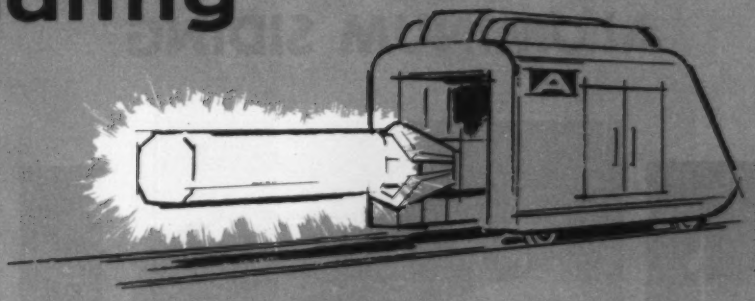
Here are just a few of its uses: Aluminum remelt furnaces • Electric furnace roofs • Alloy steel, brass, and aluminum ladles • Burner cones

0903
REFRACTORIES ENGINEERING CONSTRUCTION
Plibrico

WRITE FOR LABORATORY REPORT PLR-910 giving technical data. Ask your Plibrico Sales Engineer about the advantages of Plibrico "80".

PLIBRICO CO., 1806 Kingsbury, Chicago 14
CANADIAN PLANT: New Toronto, Ontario
Sales and Service Throughout the World

Push-button Billet Handling



Merely push a button and the billet is in position for any forging operation. Finger-tip electrical and hydraulic controls do the work.

THE ALLIANCE MACHINE COMPANY leads the way in imaginative engineering of heavy machinery for the Industry.

For YOUR greatest over-all return on your investment, look to ALLIANCE MACHINE COMPANY . . . the world's largest builders of the world's largest cranes.

Greatest over-all return for your investment

"Give Us The Runway and We'll Lift The World"

Overhead Cranes * Gantry Cranes * Mill Cranes and Equipment * Hot Metal Cranes * Ladle Cranes Stripper Cranes * Soaking Pit Cranes * Soaking Pit Cover Cranes * Charging Machines * Furnace Chargers * Slab Handling Cranes * Bucket Cranes Magnet Cranes * Mold Yard Cranes * Skull Cracker Cranes * Ingot Buggies * Run-Out Tables Car Dumpers * Special Mill Equipment * Ore & Coal Bridges * Loading & Unloading Towers Forging Manipulators * Forging Cranes * Power House & Dam Cranes * Dock & Pier Handling Equipment * Research, Development & Engineering Service * Licensees & Manufacturing Facilities in Other Countries

The Alliance machine company

Main Office • Alliance, Ohio

voltage regulator with controls.

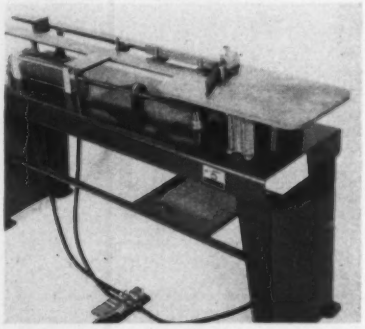
The other model is a mobile, lightweight unit for materials that can't be brought to a tester. It uses C-clamps with varying throats and an indenter head. Major and minor loads are produced by preloaded springs in an individual spring sleeve. Spring units are interchangeable for different load ranges.

See them at the show or *write* Wilson Mechanical Instrument Div., American Chain & Cable Co. Inc., 230 Park Ave., New York 17, N. Y.

Pneumatic Unit Bends Wire, Rods, and Bars

PRECISION angle bends in wire, bars, and rods can be handled by the Lubow bender. The unit can form angles, triangles, Us, squares, rectangles, pentagons, hexagons, and other shapes quickly and accurately.

The company says an operator should average 500 bending cycles an hour. The unit operates pneumatically at 80 psi or more. Capacity goes up to ½ in. bar. The bend angle is adjustable from 0 to 135 de-



grees. The unit is equipped with a speed control, pressure regulator, filter, and oiler. You can obtain a turret attachment to change angles automatically and steel extensions for front, side, and rear.

For further information, *write* Lubow Machine Co. Inc., 262 Mott St., New York 12, N. Y.

Heat Treating Furnace Is a Packaged System

A COLD wall, vacuum heat treating furnace will be introduced at the Metal Show. The unit (Model 435-585) is a completely packaged, top loading system rated up to 3000° F. Other equipment will be displayed.

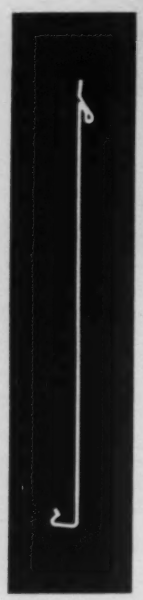
See it at the Metal Show (Booth 1625) or *write* F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

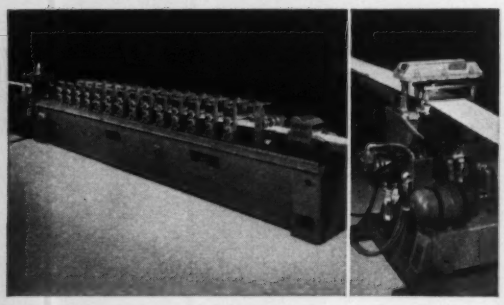
Resistance Seamwelder Joins Strip Coils

A NARROW lap, seamwelder joins strip ends for continuous processing in tinning, annealing, and coil preparation lines. The unit is equipped with a built-in strip shear, automatic conditioners for the weld wheels, strip piercing punches (for later weld identification), and an automatic preloader for the head end of the next coil.

The operator loads and prepares a coil for welding as the previously joined coil is passing through the welder. When the coil end is

AMERICAN ROLLER DIE CORP
ARDCOR
PRODUCTION EQUIPMENT
produces MILLIONS of SQUARES
of
ALUMINUM SIDING





ARDCOR typical production line includes Coil Reel, Prenotch Press, Leveller and Roll Forming Machine—with Rotary Punching Unit for piercing nail and weep holes or slots, Cut-off Press and Runout Table.

Ardcor invites your inquiries for complete cold rolled forming lines—from coil to finished product—for all shapes. Many Ardcor high production lines are in use today—some manufacturers using over 15 complete lines.

What are your requirements? Write, or phone us, today!

American ROLLER DIE CORP.
29520 Clayton Avenue Wickliffe, Ohio

AMERICAN ROLLER DIE CORP ARDCOR
DESIGNERS, ENGINEERS AND BUILDERS: Single Roll Forming Machines or Completely Automated Production Lines for Cold Forming; Ferrous and Non-Ferrous Electric Weld and Lock Seam Tube Mills • Forming Rolls, Tubing and Pipe Rolls • Straightening, Pinch and Leveller Rolls • Cut-Off Machines • Slitters

Clean

...that's stainless steel

Stainless Steel is the spotless metal for preparing the food you eat and serve. In protecting the health of your family there is no substitute for clean, corrosion-resistant Stainless Steel.

Look for the **STEELMARK** on the products you buy.

McLouth Steel Corporation,
Detroit 17, Michigan

Manufacturers of high quality Stainless and Carbon Steels

McLOUTH STAINLESS STEEL

RIVETS TIGHTEN THEMSELVES

...make longer lasting joints

Headed at 1600 to 2000 degrees F., rivets hold components tightly together by the pressure produced by the riveting equipment.

As the rivets cool, the contraction along the length of the body creates a vise-like tightening action that increases until the rivets are cold . . . then maintains this tremendous grip . . . forever!

For permanence, you can't beat rivets.

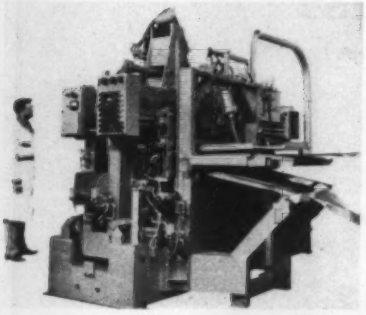
The CHAMPION RIVET Company
East 108th Street and Harvard Avenue
T. PIERRE CHAMPION, President
CLEVELAND 5, OHIO

RIVETS • UPSET FORGINGS
SPECIAL WELDING ELECTRODES

Wide selection of 3/16" to 2" diameter rivets in stock, available for immediate shipment. Send for complete catalog showing sizes, specifications, heating charts.

reached, an automatic cycle mechanically feeds the prepared head end into welding position, square shears the strip ends, and quickly welds them together.

Total time for strip handling, shearing, and welding is 15 seconds

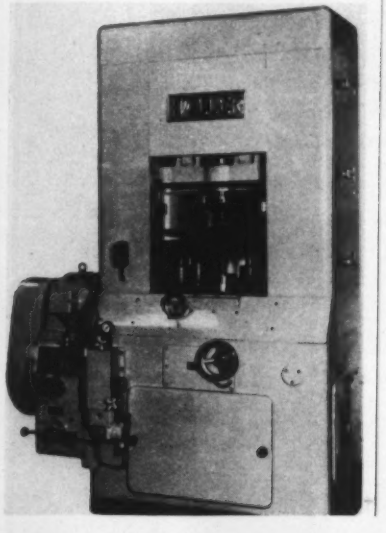


for a 46 in. strip. The machine can handle strip 0.004 to 0.036 in. thick. The company states the weld has been run at full speed through temper mills and other equipment.

For further information, *write* Taylor-Winfield Corp., 1048 Mahoning Ave., Warren, Ohio.

Briqueting Press Handles Variety of Materials

CERAMIC materials, powdered metal, carbon, and other powdered materials can be handled by a 40 ton powder briqueting press. A hydraulically controlled floating die table helps insure uniform distribution of density throughout the compacts.



A compact, hydraulic unit provides infinitely variable control of the relative bottom pressure. The table float can be stopped in any position.

A three speed gear transmission provides speeds of 10 to 19 strokes per minute. Tool setup is facilitated by a self-centering, lower punch adaptor. Upper punches are clamped to the upper ram which has two bolt circles to handle small as well as large punches.

For further information, *write* Haller Inc., 16580 Northville Rd., Northville, Mich.

Lift Rated to 6000 lb

NO FOUNDATION is required for the Wayne lift (Cabl-Lift). Plates are provided on the corner posts for bolting to the floor if a permanent installation is desired.

(*Please turn to Page* 214)

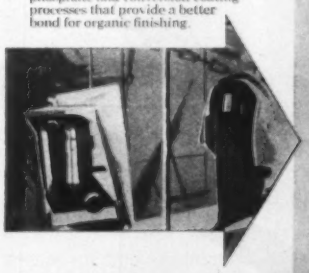
Here's the
PHOSPHATE COATING
You asked **TURCO TO MAKE**

HERE'S HOW PAINTITE SCORES ON SURVEY'S 12 "MOST WANTED" FEATURES...

—Formulated as Result of Industry-Wide Survey...

During the first six months of 1959, Turco undertook an extensive survey of the phosphate coating market. Hundreds of users of these coatings were interviewed. Thousands of questions were asked. When the answers were tabulated, Turco began the task of building an iron phosphate process to the *exact specifications* called out in the survey.

The new process is now available. It is called Turco Paintite. Paintite has been thoroughly field-tested in the production lines of a dozen Turco customers. It has passed the most severe tests with flying colors. Turco is proud to announce the addition of Paintite to its ten other Turcoat phosphate and conversion coating processes that provide a better bond for organic finishing.



1. **SUPERIOR CLEANING**–Exclusive wetting system provides heavy-duty uniform cleaning. Cleans & phosphates simultaneously.
2. **TEMPERATURE VERSATILITY**–Efficient anywhere within range of 140° to 180°F. Temperature control is not important.
3. **LOW FOAMING**–at any temperature within recommended range.
4. **LESS POST RUST**–Eliminates post rusting problem often encountered with iron phosphate processes.
5. **NO WHITE STREAKING**–Extra free rinsing. Leaves no residue.
6. **ECONOMICAL**–Low in initial cost. Low in maintenance cost. Low in cost per sq. ft. Long-lived, even under mass production use.
7. **UNIFORM COATING**–even on edges and points. Won't show through on low-pigmented paints.
8. **USE VERSATILITY**–used by immersion, spray washer or steam cleaner.
9. **LESS SLUDGE**–less scale. Minimizes clean-up problems.
10. **RESERVE ACIDITY**–combats alkaline water conditions. Constant control not necessary.
11. **SUPERIOR SERVICE**–by Turco's vast network of technically trained servicemen, located in industrial centers throughout the world.
12. **REQUIRES ONLY 3 STAGES**–for dip or spray washing. Can be efficiently used in 5-stage operations, if desired.

FREE! VALUABLE BOOKLET
PHOSPHATING REFERENCE CHART
TECHNICAL DATA BULLETIN

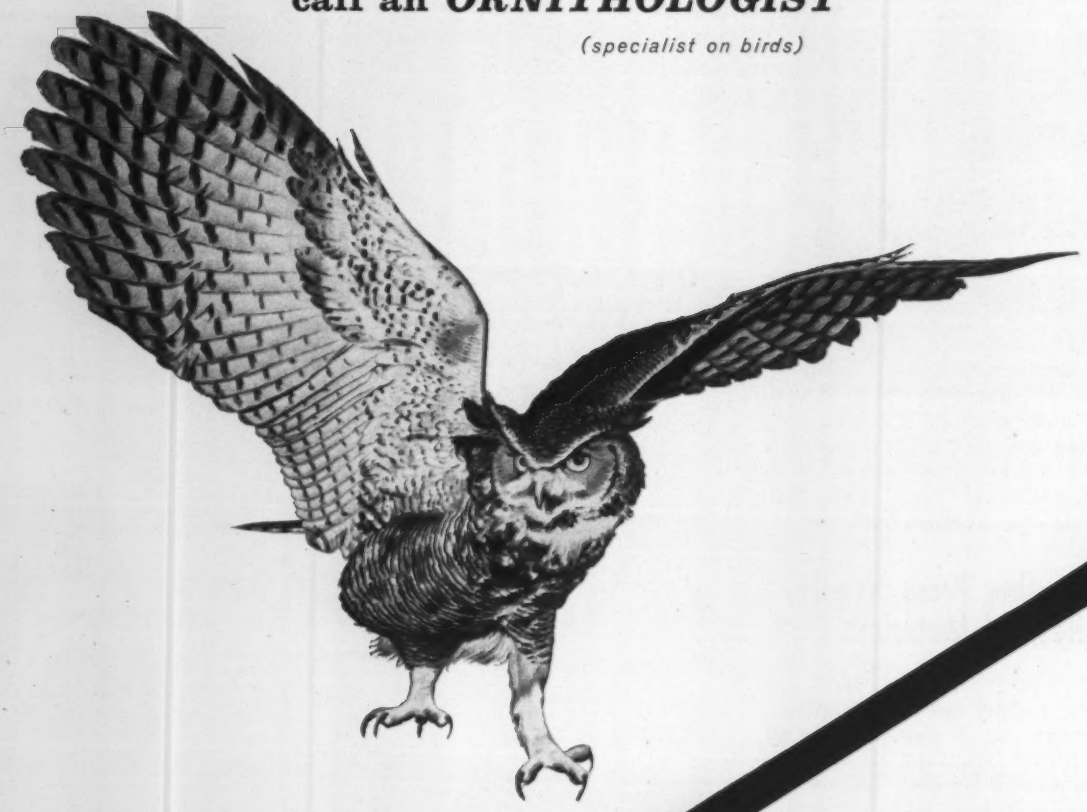
Get the full story on Paintite and the other ten phosphating and conversion coating processes in the complete Turcoat line. Write for your copy, along with Turco's Phosphating Reference Chart, today!

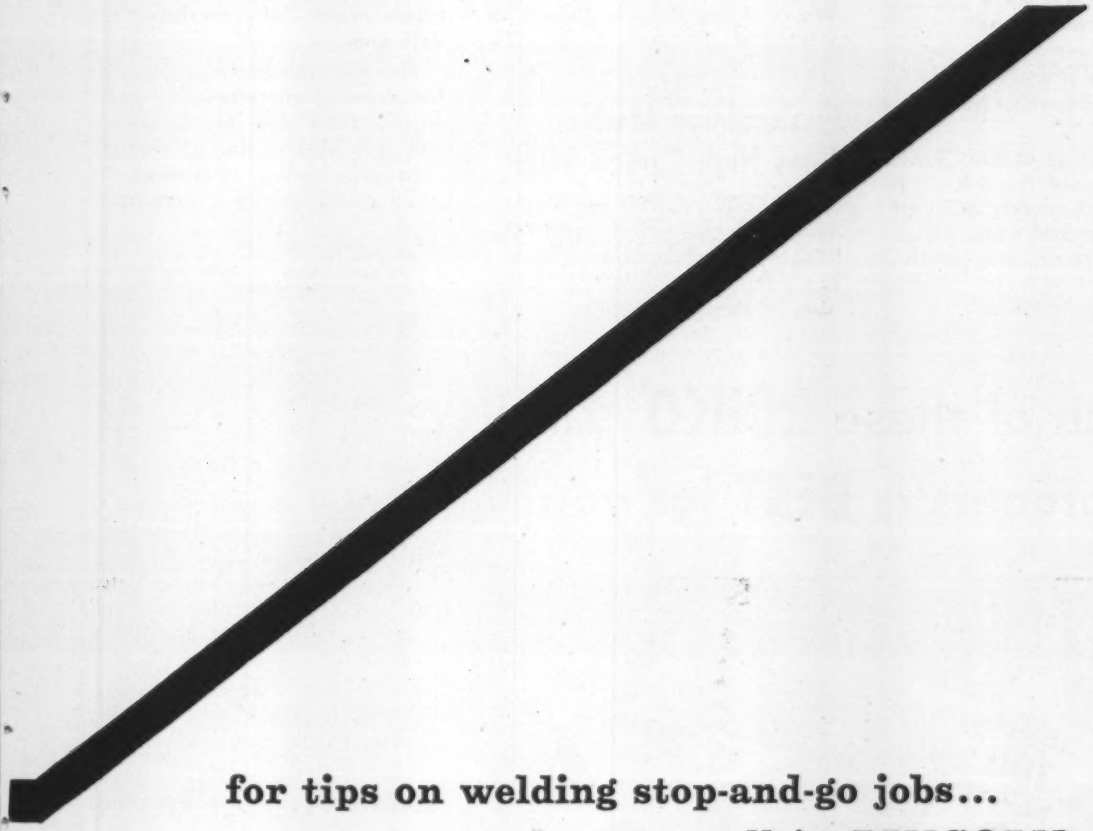
TURCO PRODUCTS, INC.
Chemical Processing Compounds
24600 South Main Street, Wilmington, California
FACTORIES: Rockdale, Ill., Houston, Wilmington, London, Rotterdam, Sydney, Mexico City, Paris, Hamburg, Montreal, Manila, Naha (Okinawa)
Offices in All Principal Cities

TURCO PRODUCTS, INC.
24600 South Main St., Wilmington, Calif.
MERELY AFFIX COUPON TO COMPANY LETTERHEAD
Please send valuable booklet with Phosphating Reference Chart and full details on Paintite. I understand there is no cost or obligation on my part.
NAME
TITLE

For tips on finding the Great Horned Owl...
call an *ORNITHOLOGIST*

(specialist on birds)





for tips on welding stop-and-go jobs... call in *LINCOLN*

(specialists in arc welding)

A KANSAS MANUFACTURER OF MOBILE HOMES doubled the welding speed on his undercarriages by simply changing electrodes—and in addition, saved over $8000 in the first year.

Manufacturing cost on undercarriage fabrication was prohibitive. Thirteen gauge cross members were welded to twelve gauge channels by welds made in both vertical and flat positions. These short welds on steel having some scale and oil slowed down production.

Finally they called in their LINCOLN Field Engineer. Painstaking tests, made by the LINCOLN man with the welding foreman and plant superintendent, proved LINCOLN's Fleetweld 37 electrodes far better for this application.

RESULTS: lower costs . . . welding speed doubled . . . cleaning time cut in half.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

THE LINCOLN ELECTRIC COMPANY
Dept. 2940 • Cleveland 17, Ohio

LINCOLN WELDERS

NEW PRODUCTS and equipment

(*Concluded from Page* 211)

Portable units have floor frames and swivel casters.

Capacities go up to 6000 lb with a platform size of 6 ft x 8 ft 6⅞ in. Three standard models are available. The standard motor (totally enclosed, dirtproof and weatherproof) is rated at 1 hp. Special voltages can be specified.

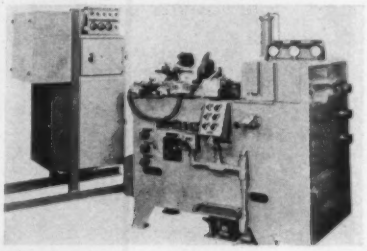
For further information, *write* Wayne Pump Co., a division of Symington Wayne Corp., Ft. Wayne, Ind.

Flashwelding Machine Joins High Carbon Wire

A FLASHWELDING machine for welding high carbon wire (¼, 9/32, ⅜, and 9/16 in. in diameter) has a timed, forced control mechanism for synchronizing flashing and upset and an automatically controlled system for normalizing the weld area.

The manufacturer says the joint has drawing characteristics equivalent or better than the parent wire and says welding time is reduced.

Lateral platen movement is timed and regulated automatically

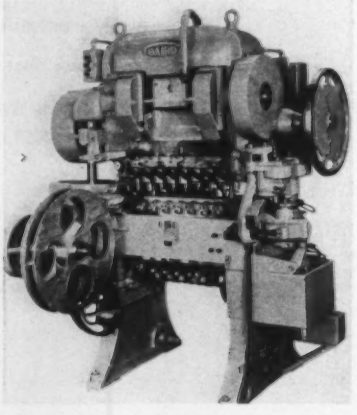


to correspond to welding heats and upset forces needed for various thicknesses and grades of wire stock. A water cooled transformer rated 30 kva at 50 per cent duty cycle and a series-parallel switch provide 16 points of heat.

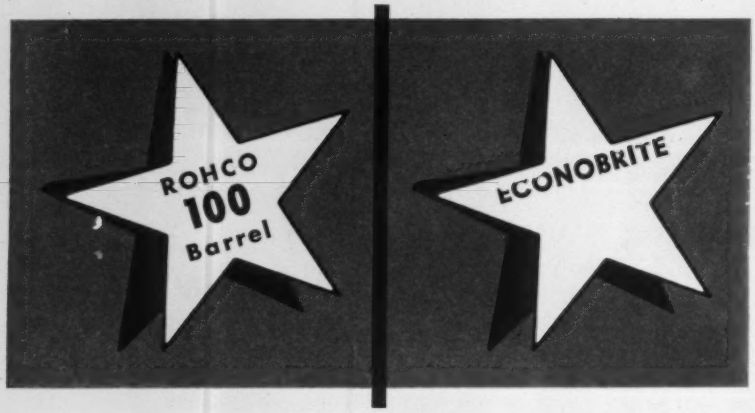
For further information, *write* Thomson Electric Welder Co., 161 Pleasant St., Lynn, Mass.

Multiple Transfer Presses Undergo Design Changes

FOUR design changes have been announced for Baird's multiple transfer presses: 1. Longer ram strokes permit deeper draws and production of a greater range of parts. 2. An electric clutch brake can stop the machine in ½ revolution to prevent tool damage. 3. In the roll feed, the roll and mounting shaft have one piece construction. 4. Empco-bronze bushings are located at the transfer finger



Which of these ROHCO® Zinc Brighteners is BEST for you?



If it is greatest brilliance with 3-D depth for mirror-like finish that you want, ROHCO 100 Barrel Zinc Brightener produces like the champion it is. What's more, it exhibits highest covering power that puts substantial thickness of deposit in recesses usually unplated. Your customer will notice the difference, too.

For plated parts that call for utility bright deposits—where bright dipping after plating may be planned—ROHCO Econobrite Barrel Zinc Brightener cannot be equaled in quality with economy. This latest development is an exceptionally powerful barrel zinc brightener for cyanide zinc plating baths.

CONVERSION COATINGS FOR ZINC

ROHCO developments in RODIP powders, one dip or leach dip conversion coatings, offer a wide variety of low cost finishing effects—Brightening, Corrosion Protection and Paint Bonding. Colors for zinc vary from a clear, blue white to a definite bluish coating.

Write for ROHCO Technical Bulletins on 100 and Econobrite Barrel Zinc Brighteners and RODIP Conversion Coatings. To obtain excellent results sooner, send in your trial order now—you'll be glad you did!

ROHCO

-------- Nationwide Stockpoints --------

R. O. HULL & COMPANY INC.

1309 Parsons Court • Rocky River 16, Ohio

The RIGHT START . . . a BETTER FINISH

40-ton Plymouth Diesel speeds pulpwood hauling for Heald Division of Mead Corporation, Lynchburg, Va.

"No down-time to date"—reports this Plymouth user

Tough, trouble-free Plymouths give years or dependable service. Take Mead Corporation's Heald Division, Lynchburg, Va., which recently replaced a 25-ton Plymouth Locomotive—in daily use for 20 years—with a 40-ton Plymouth Diesel. The new Cab-in-Front Model WDT with 6 wheel drive operates 16 hours a day, averages more than 6 round-trips daily between the storage yard and the mill. This double-duty work period requires constant hauling and switching plus intermittent shifting and spotting of cars. Grades range to 3% and even higher.

Company reports: "No down-time for repairs in over 9 months of continuous operation. Routine servicing requires only one-half hour per week."

Plymouth's high operating efficiency and low operating cost make hauling, switching and spotting jobs more profitable for large and small companies everywhere. Whether your requirements call for gasoline or Diesel power, mechanical or torque-converter drive, we will gladly send you complete information on a Plymouth built specifically to meet your haulage needs. Send a brief outline of *your operations* to: The Fate-Root-Heath Company, Dept. A-1, Plymouth, Ohio. Purchase Plans are available.

RAIL POWER

PLYMOUTH® LOCOMOTIVES

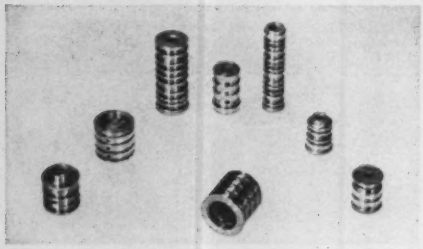
WITH TORQOMOTIVE DRIVE

Also Builders of F-R-H Ceramic Machinery

PLYMOUTH LOCOMOTIVES in Progressive Industry throughout the world

WHY MICROHONING* helps Hawk Guidance System "think" straight

The Army-Marine surface-to-air Hawk missile is the first of its kind to overtake and destroy a ballistic missile in a simulated enemy attack. Designed by Raytheon's Missile Systems Division, it is being built at their Andover, Massachusetts plant.



Representative range of valve sleeves Microhoned.

MICROHONING GENERATES ACCURACY

With consistent accuracy as a prime requisite, Raytheon engineers specify Microhoning in the processing of valve sleeves and blocks used in the servomechanism that guides the Hawk in its supersonic flight. Microhoning of bores rectifies geometric inaccuracies, size is held within .0003", roundness within .0001" tolerance, and a surface finish of about 8 microinches (rms) is generated.

MICROHONING'S VERSATILITY

Thirteen different sizes of sleeves and blocks are Microhoned, including those with blind-end, interrupted, and ported bores. Parts, which are generally of stainless steel heat treated to 58-60 R "C", have bore diameters ranging from .171" to .874" and lengths from .594" to 2.859".

STRAIGHT, CLEAN BORES

Microhoning of these components effectively corrects camber or bow in the bore and assures less smear around the ports than possible with any other machining method. Bore camber and smear could cause binding or a hindering action between the sleeve and its spool, and thus throw the missile off-course.

The strong emphasis on precision can best be appreciated in the realization that sleeves and mating spools must operate within a clearance of only 100 to 150 millionths of an inch. The fit of the spool within the sleeve must prevent blow-by. A final lapping operation provides geometric accuracy within .000050" tolerance.

For further details, see facing page.

**Registered U. S. Pat. Off.*

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

NEW PRODUCTS and equipment

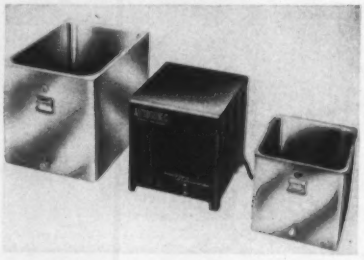
bearing in the transfer slide.

For further information, *write* Baird Machine Co., Stratford, Conn.

Ultrasonic Cleaners Don't Require Tuning

CONSTANT maximum efficiency can be maintained in big cleaning jobs with the Series 1000 ultrasonic cleaners. The units do not require attention or tuning and maintain optimum performance. A feedback transducer electronically compensates for all varying load conditions.

The basic generator for the heavy duty cleaning system, the Autosonic Model PA-10001, has an average output of 1 kilowatt with a 4 kilowatt peak. Multiple units may be



combined in modular installations to give up to 10 kw operation. Special equipment can be produced to specifications.

For further information, *write* Powertron Ultrasonics Corp., Patterson Place, Roosevelt Field, Garden City, N. Y.

Motor Alternators Require Minimum Maintenance

BRUSHLESS motor-alternator combinations in a new series have no moving electrical contacts. Maintenance has been reduced to a routine inspection every three to five years.

The combinations are available in three forms with two, standard output frequencies (60 and 400 cps nominal). Five standard output ratings are available.

For further information, *write* Electric Specialty Co., Stamford, Conn.

NEW literature

Write directly to the company for a copy

Welding Manual

A 56 page booklet (in English or Spanish) includes instructions on manual welding, brazing, soldering, cutting, and tinning. All-State Welding Alloys Co. Inc., White Plains, N. Y.

Properties of Glass

Such characteristics as thermal stress, heat transmission, electrical properties, corrosion resistance, and viscosity data are included in a 16 page pamphlet. Ask for the revised edition of "Properties of Selected Commercial Glasses." Corning Glass Works, Corning, N. Y.

Wire Construction

A manual includes case histories showing the application of wire and strip metal components. It discusses wire types, finishes, sizes, and a variety of end treatments. Custom Design Dept., E. H. Titchener & Co., 57 Clinton St., Binghamton, N. Y.

Flexible Shaft Handbook

The book describes flexible shafts, and discusses applications, advantages, and design information. Dept. P, Industrial Div., S. S. White Dental Mfg. Co., 10 E. 40th St., New York 16, N. Y.

Lightning Damage

"Lightning Facts and Figures" presents information about protection and damage (property losses total more than $125 million annually). Lightning Protection Institute, 53 W. Jackson Blvd., Chicago 4, Ill.

Cobalt Alloys and Cermets

Two publications cover cobalt alloys, nickel alloys, and cermets. A 4 page bulletin lists physical and mechanical properties, corrosion resistance, thermal treatment, fabrication, forms, and applications of 13 nickel and cobalt base alloys. *Thermal Shock and Thermal Fatigue of Cobalt Alloys and Cermets* (65 pages) is a compilation of references from 1938 to 1960. It includes a brief introduction, 84 abstracts, 14 tables, and 13 figures. Cobalt Information Center, Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.

Calculation Chart

The Cylinder Force Calculation Chart helps to determine hydraulic or pneumatic cylinder sizes for given work functions. The chart is available from distributors and application engineers. Sheffer Corp., 326 W. Wyoming Ave., Cincinnati 15, Ohio.

Swaging Advantages

A publication (SM-60) includes a discussion of swaging applications, advantages, and Hydroforming techniques. Fenn Mfg. Co., Fenn Road, Newington, Conn.

HOW MICROHONING corrects camber in components of Hawk Missile

Raytheon, designer and builder of Hawk missiles, is constantly seeking to improve processing methods and attain greater precision-production. One example of this is the processing of valve sleeves and blocks used in the steering mechanism of Hawk missiles. Here's how Microhoning corrects bore camber, minimizes smear around ports, generates geometric accuracies and microinch surface finishes.

CORRECTING BORE CAMBER

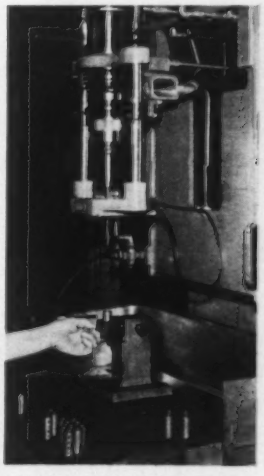
To straighten bore surfaces so that they are parallel throughout their length to the neutral axis of the bore, Microhoning utilizes the combination of: abrasive sticks of exact length, positive radial expansion of abrasives, and controlled rotating and reciprocating motions of the Microhoning tool.

Each Hydrohoner has automatic *size control, stonefeed and stonewear compensation.*

MINIMUM SMEAR AT PORTS

Thirteen different sizes of sleeves and blocks are Microhoned, including those with blind-end, interrupted, and ported bores.

The Microhoning characteristics of low-velocity abrading and constant widespread contact with bore surfaces eliminate more smear around the ports than is possible with any other machining method.



Simple fixturing and hand loading are part of this careful processing.

EFFICIENT PRECISION PROCESSING

In two Microhoning operations, from .002" to .006" stock is removed from the bores at an approximate rate of .001" per minute. The rough Microhoning removes from .001" to .005" stock while correcting camber to within .0003". The finish Microhoning rectifies geometric inaccuracies resulting primarily from heat treating of parts. Size is held within .0003", roundness within .0001" tolerance, and surface finish generated is about 8 microinches, rms.

For further details, see facing page.

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

USE *Acme-Newport* RED CIRCLE SERVICE *for Your Spot Orders*

Acme-Newport offers you the answer to imbalance in steel inventory. Mark your order for *Red Circle Service* and it catches the attentive eye of every mill man from our order desk to the shipping department. Every rush order bears the bright *Red Circle* that gives it preferential treatment all along the line. Same high quality; same modern facilities; same skillful handling; same unhurried series of laboratory checks . . . *plus* our flexibility of operation and scheduling, and extra effort to get you off the shortage hook! When you need it good and you need it fast, give Acme-Newport a call!

PRODUCTS OF ACME-NEWPORT STEEL

- Hot Rolled Steel in Coil
- Hot Rolled Pickled Steel in Coil
- Hot Rolled Sheets
- Hot Rolled Pickled Sheets
- Cold Rolled Steel in Coil (*full hard only*)
- Cold Rolled Sheets
- Alloy Sheets and Plates
- Plates ($\frac{3}{16}$" *and lighter*)
- Electrical Sheets
- Electric Weld Line Pipe
- Spiral Welded Pipe

Steel

Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY

Cautious Buying Slows Upturn

WORRIES ABOUT RECESSION, global war, and November elections are keeping many steel buyers out of the market and slowing the pace of recovery. In almost every sector of the economy, there's a strong inclination to wait and see—to ponder now and act later.

Metalworking executives are reappraising the economy and asking themselves whether they should go ahead with spending plans. Consumers are worrying about layoffs and wondering whether to buy now or postpone their purchases of cars and refrigerators.

AUTOMAKERS WARY— In Detroit, there are plans to build 663,000 cars this month (vs. 408,000 in September). But automakers admit they're concerned about three problems: 1. Nearly 900,000 unsold 1960 models. 2. Weakness of the used car market. 3. Disappointing sales in August and September. Unless there's a quick pickup in retail sales, October schedules may be sharply curtailed. Chrysler Corp. has already announced cutbacks at some of its Ohio plants. Ford Motor Co. and General Motors Corp. are still talking about big fourth quarter output, but they're not going overboard on steel buying. One of the GM car divisions (not including its affiliated Fisher body group) has a four month supply—two months in inventory and two months in process.

WHAT NEXT, UNCLE SAM?— In the farm equipment industry, manufacturers are delaying steel purchases until they see who moves into the White House. They want to size up the new farm program and decide how it will affect customers' pocketbooks before making final decisions on production. In other segments of metalworking, manufacturers are wondering how they'll be affected by the next administration's fiscal policies and expenditures for defense, housing, school construction, and roadbuilding.

STAINLESS BRIGHTENS—Stainless was hard hit by inventory liquidation early in the year, but a gradual recovery is developing. Experts thought 1960 shipments might break the record of 688,000 tons set in 1956. Now they're guessing that it will take a strong fourth quarter (shipments of 144,000 tons) to push this year's total up to 600,000 tons. Immediate prospects hinge on how well the new cars go over and which models sell best. De luxe compacts will have more stainless trim than the economy models introduced last year but may use less brightwork than the standard size cars they displace.

SCRAP FALTERS—Scrap prices, once regarded as a barometer of steel industry operations, fell last week amid signs of a modest upturn in steel buying. STEEL's composite price of the No. 1 heavy melting grade dropped 66 cents to $30.67 a ton—the lowest quotation since September, 1954. Scrap may be a false prophet now, but it gave a better clue to the future in June and July (by refusing to go up) than industry spokesmen who predicted September would bring a strong recovery in steel.

PRODUCTION SKIDS— Last week, steelmakers operated their furnaces at 52.6 per cent of capacity, 2.1 percentage points below the previous week's revised rate. Output: About 1.5 million ingot tons. A strike by trainmen serving the Lackawanna plant of Bethlehem Steel Co. reduced operations to 9 per cent in the Buffalo district and pulled down the national rate. In most of the other districts, production was steady or slightly higher.

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*Current prices were published in the Oct. 3 issue and will appear in subsequent issues.

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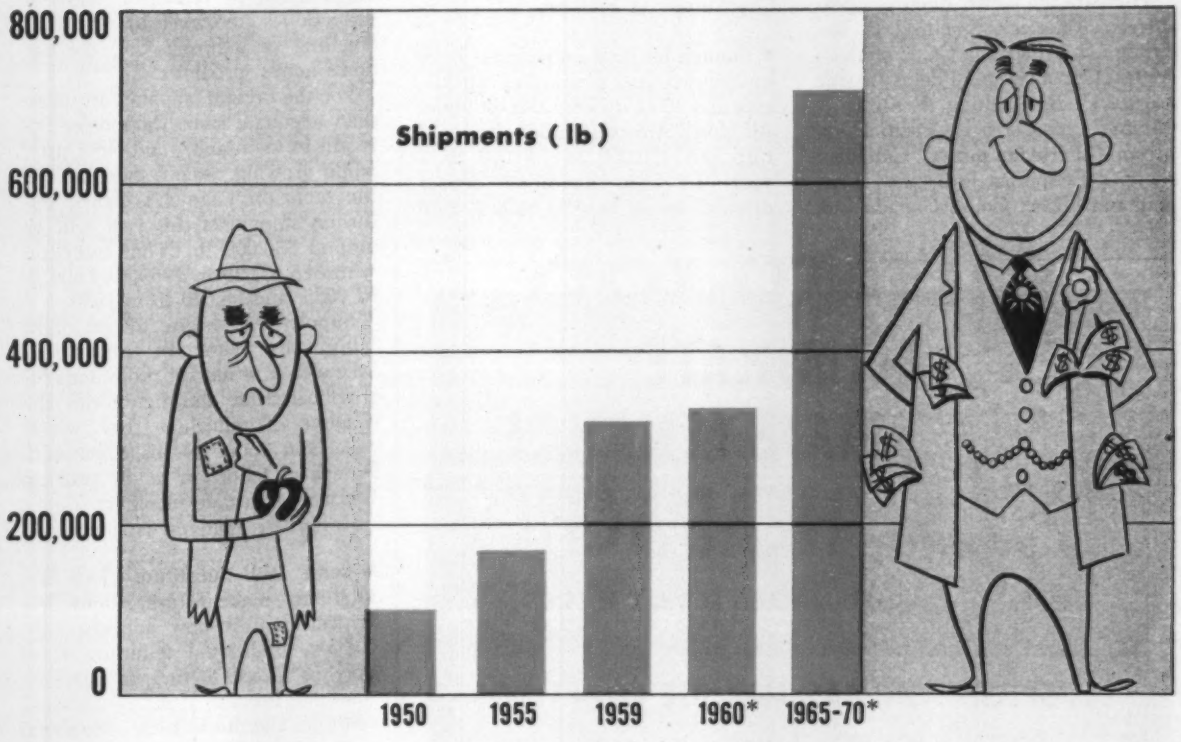
Tellurium Story—From Rags to Riches



All figures are for North America.
Source: U. S. Bureau of Mines.
*Estimated. Annual rate for 1965-70.

Copper's Stepchild Prospers as . . .

Thermoelectrics Spurs Boom

TELLURIUM was discovered in 1782, but until 18 months ago, some producers didn't even bother to recover it.

Now it's a high priced glamour metal with so much potential that people are already talking about future shortages.

The reason for its overnight success: Thermoelectrics.

• **Best Material Available**—Tellurium is about twice as rare as gold, but nature endowed the metal with unique properties. Tellurium compounds (like bismuth telluride) have the highest known capacity for heat and electrical generation.

Devices employing thermoelectric principles of heating, cooling, and power generation are already in use (see STEEL, Feb. 29, p. 57). Earliest big applications will probably be in small (1 to 2 cu ft) refrigerators, emergency and remote power generation, and in a variety of military items. But the sky is the limit. Advocates think thermoelectrics will eventually take over the major share of heating and power generation.

• **Supplies Limited**—Supply of tellurium may become a problem. There is no known concentration that's large enough to be mined, and U. S. Bureau of Mines mineralogists who have been scouting for new sources are doubtful if one will ever be found.

Tellurium is obtained as a by-product of electrolytic copper refining, and small amounts are recovered in lead refining. Not many copper ores contain tellurium, and tellurium has not been found as a byproduct material in the newer copper mines.

Luckily, the bulk of the Free

World supply is in the U. S. and Canada. Small amounts are produced in Japan, Germany, and Finland. The Soviet Union has tellurium, but the extent of its reserves are unknown.

Here are the North American producers: American Smelting & Refining Co., Anaconda Co., American Metal Climax Inc., Phelps Dodge Corp., U. S. Smelting, Refining & Mining Co., Cerro de Pasco Corp. (from its Peruvian mines), Canadian Copper Refineries Ltd., and International Nickel Co. of Canada Ltd. Kennecott Copper Corp. mines tellurium-bearing copper ores but currently doesn't recover the metal.

Overseas tellurium producers are: Nippon Mining in Japan, Nordeutsche Affinerie in Germany, and Outokumpu in Finland.

• **Enough for Now**—Producers have inventoried their production capabilities and come up with this estimate: All North American producers could turn out 710,000 to 750,000 lb a year. To reach that figure, copper demand would have to be at a high rate, and no producer will mine unneeded copper just to get tellurium. Backstopping production potential is an estimated 1 million lb of tellurium that can be refined from muds and residues that have been accumulated by refineries. Most of the residues are owned by American Smelting & Refining Co., the nation's largest producer.

For the present, supplies are more than adequate since thermoelectrics is still in its infancy, and older uses, while growing, aren't spurting. As the table on Page 221 shows, tellurium shipments this year will be around 330,000 lb. That compares with 316,403 lb in 1959, 164,800 lb in 1955, and 98,070 lb in 1950.

Supply will begin to get tight within five years. In fact, if you take a look at market projections for thermoelectrics and figure out the amount of tellurium they would take, you come to this conclusion: A lack of tellurium might hold up thermoelectrics development unless an alternate material is uncovered.

• **Some Will Substitute**—Two factors may make future supply less critical than it now appears.

First, traditional tellurium users may be forced to turn to alternate materials because of price—releasing more for thermoelectrics. The metal is used in rubbermaking (as a vulcanizing agent), free machining copper, chilling cast iron, and as a catalyst for chemicals. Such uses have been growing—especially in rubber.

Prices have been going up. Several hikes in the last 18 months have doubled the price of commercial grade to $4-$5 a pound. High purity tellurium, used in thermoelectric applications, costs up to $30 a pound. The price trend seems to shape up this way: Commercial grade prices will continue on the uptrend; prices on high grade will come down as demand mounts.

Second, the shift to substitutes will mean little unless more efficient use is made of available supplies. Producers and thermoelectrics people are optimistic. For example, a use that takes a pound of tellurium today might require only 3 ounces five years hence.

• **Timetable**—Expectations are that demand will peak in the last half of the decade, probably around 1967 or 1968.

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Iron-Steel Exports Top Imports During July

Exports of iron and steel products in July exceeded imports, tonnagewise and valuewise. At the same time, export tonnage in the first seven months was substantially less than that for imports, but dollar value was greater (dollar value for imports is generally defined as market value in the foreign country, excluding U. S. import duties, ocean freight, and marine insurance).

July exports, including some fabricated items and ferroalloys, totaled 359,902 net tons (valued at $76,121,503). Imports in the month amounted to 231,471 tons (valued at $31,526,227). In July, 1959, exports were 213,688 tons (valued at $51,603,042), while imports that month amounted to 571,924 tons (valued at $63,144,835).

Exports in the first seven months this year were 2,028,233 tons (valued at $455,780,985). Imports in the period were 2,766,227 tons (valued at $388,492,559). In the first seven months last year, exports totaled 1,608,888 tons (valued at $374,122,481), whereas imports amounted to 2,864,724 tons (valued at $322,288,495).

During July, exports were heaviest in cold rolled sheets, 152,494 tons (valued at $25,452,206). Imports were heaviest in concrete reinforcing bars, 44,965 tons (valued at $4,138,731). In July, 1959, exports of cold rolled sheets were only 21,008 tons (valued at $4,262,591). Imports of reinforcing bars that month were 87,155 tons (valued at $7,135,379).

Wire . . .

Wire Prices, Pages 233 & 234

Both manufacturers' and merchant wire items are in listless demand. Pacing the market are requirements for welded wire fabric for road and bridge construction.

Ferroalloys . . .

Ferroalloy Prices, Page 238

Exports of ferroalloys totaled 3698 net tons (valued at $944,659) in July, reports the Commerce Department. Imports were 5409 tons (valued at $1,458,571). In July, 1959, exports amounted to 5683 tons (valued at $991,425), and imports were 12,115 tons (valued at $4,137,850).

During the first seven months this year, exports amounted to 39,351 tons (valued at $5,331,174). In the like period, 1959, they were 42,034 tons (valued at $4,572,908).

Imports in the first seven months this year were 59,362 tons (valued at $17,852,390). In the like 1959 period, they were 73,507 tons (valued at $21,886,974).

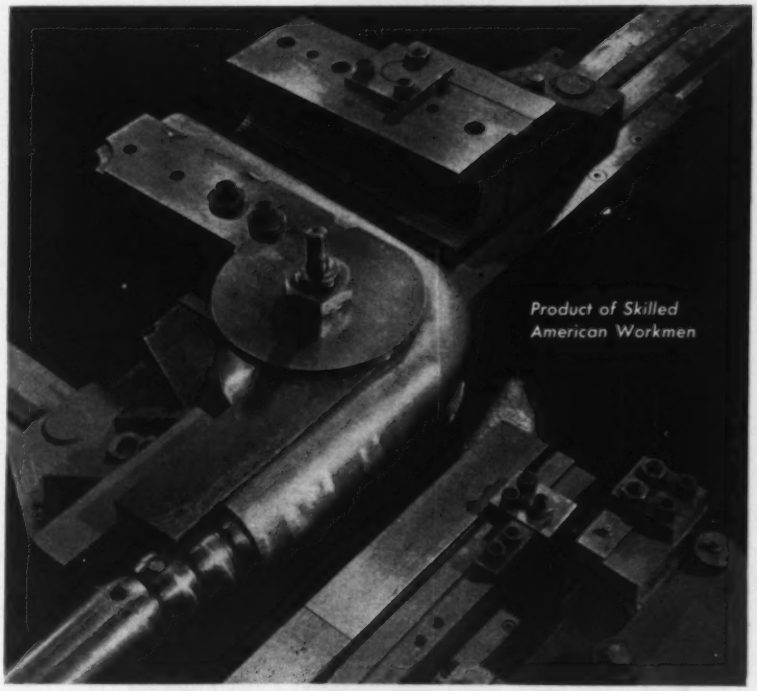
Here's the latest report on consumption and stocks of manganese ferroalloys and metal in the U. S.

Consumption in June: Ferromanganese, 53,394 tons of high carbon, 4830 tons of medium and low carbon; silicomanganese, 6256 tons; spiegeleisen, 2667 tons; manganese metal (electrolytic and electric furnace metal), 1221 tons; briquets, 628 tons.

Consumption in the first six months, 1960: Ferromanganese, 452,777 tons of high carbon, 41,275 tons of medium and low carbon; silicomanganese, 57,626 tons; spiegeleisen, 22,489 tons; manganese metal, 7691 tons; briquets, 4030 tons.

Consumers' stocks at the end of

COLUMBIA
TOOL
STEELS



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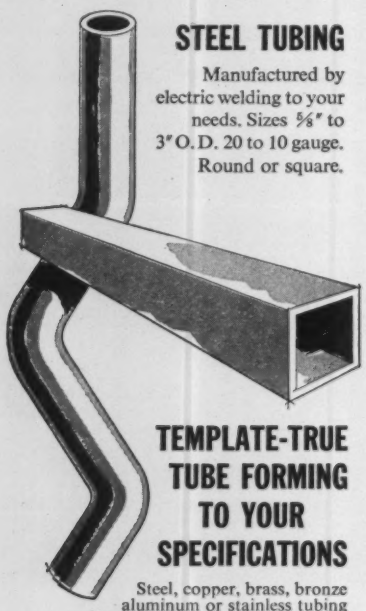

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Formed Tubes, INC.

June: Ferromanganese, 122,800 tons of high carbon, 10,546 tons of medium and low carbon; silicomanganese, 11,960 tons; spiegeleisen, 11,551 tons; manganese metal, 1261 tons; briquets, 1249 tons.

Tin Plate . . .

Tin Plate Prices, Page 233

Completion of a third electrolytic tinning line at Inland Steel Co.'s steel plant in East Chicago, Ind., was announced last week by the company. It increases the company's tin plate production 60 per cent to 435,000 tons annually, and enables it to produce the metal in coils and sheared lengths. Tin can manufacturers are now using coiled tin plate for much of their production.

Steel Bars . . .

Bar Prices, Page 231

While business in steel bars isn't brisk, orders are inching upward, and it now looks as though October volume will better that of September. Some producers think November will probably see the second half peak in ordering. Despite the pickup in orders, volume leaves much to be desired, with few mills producing at more than 60 per cent of capacity.

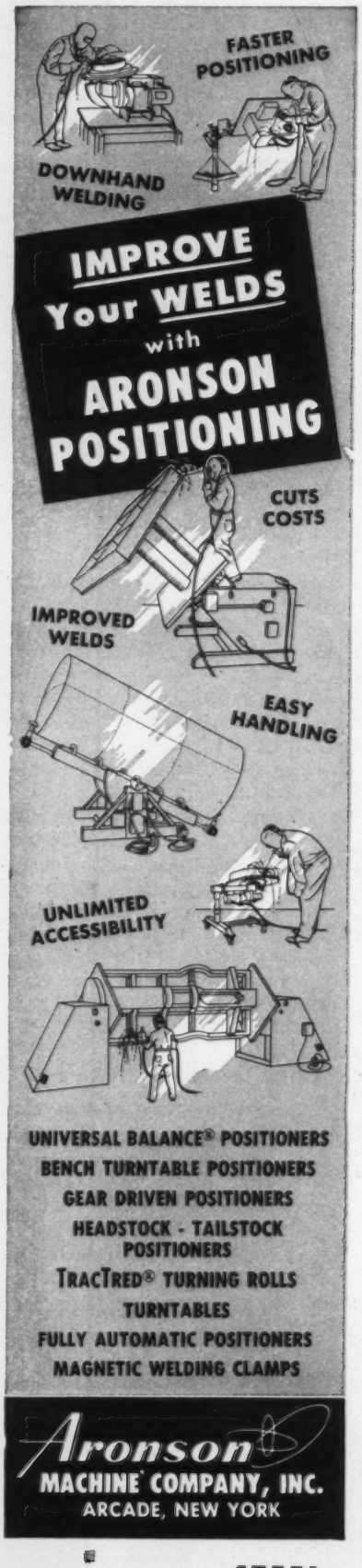
Sheets, Strip . . .

Sheet & Strip Prices, Pages 232 & 233

Demand for hot and cold rolled sheets is up a little, but is still generally disappointing. October business was up less than had been expected—consumers were still drawing on their inventories, or depending on quick shipments from the mills.

Automotive requirements lead demand, though they are not as heavy as had been anticipated. An automotive stamping plant at Pittsburgh will buy about 50 per cent more steel this month than it took in September, and two and a half times as much in November. Parts for 1961 models are being turned out on a full production basis, 21 turns a week.

September bookings of a leading Pittsburgh area producer were 25 per cent above August's, and it's hoped that October orders will continue at the same level. Many of the new orders specify rush de-



livery—even some calling for production-size tonnages—indicating that some users have reduced their inventories to a minimum.

Industrialists Tour New J&L Cleveland Warehouse

About 2500 industrialists last week toured Jones & Laughlin Steel Corp.'s new electronic-equipped Cleveland service center. Invitation to an open house was issued by officials of the J&L Steel Warehouse Div. The warehouse, completed early this year, at a cost of around $1.5 million, contains over 140,000 sq ft of floor space. It's on a 10 acre site in Maple Heights, Cleveland suburb.

The service center is equipped with special machinery for stocking and handling all types and sizes of bars, structurals, plates, and sheets. It can tailor them to customers' exact specifications. Featured is an automatic stack rack for 1350 different sizes of bars and tubes. It's more than 22 ft high, and covers an area 60 by 160 ft. Individual racks have three shelves that hold 3 tons each. The rack operator can select and deliver a stack of steel in less than 3 minutes.

J&L's warehouse also features x-ray equipment that records variations in slit coils as small as 0.0001 in. visually and on a graph. Electric eye tracing devices are used on a multiple flame cutting machine.

The Cleveland warehouse (rounding out 30 years' operation, beginning as Hamilton Steel Co.) is one of the largest in the J&L national service center chain. Hosts at the open house were George L. Stewart, president of the division, and Robert W. Harwood, manager of the Cleveland warehouse.

Distributors . . .

Prices, Page 236

Steel service centers anticipate a pickup in October, but are cautious in their predictions. They were disappointed by September bookings which were about on a par with those in August. On a daily rate, September showed an improvement of 3 to 5 per cent, but no gain in the month's total tonnage due to fewer business days.

Inventories are somewhat larger than desired in plates, shapes, and bars; normal in other products.

In the Southwest, prices on im-

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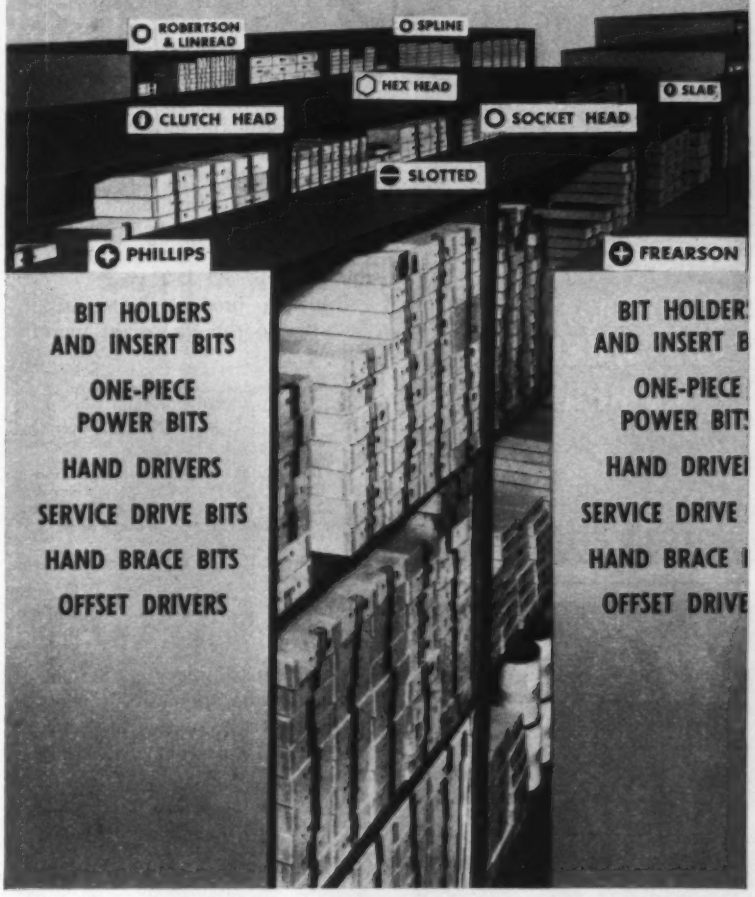

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ported material have remained firm for five months.

August Steel Shipments Register 8 Per Cent Jump

Shipments of finished steel direct from the mills during August totaled 5,071,953 net tons, reports the American Iron & Steel Institute. That's a jump of about 8 per cent compared with shipments of 4,710,565 tons in July. In August, 1959, when most of the mills were closed by the strike, only 1,338,609 tons were moved.

Through the first eight months of this year, shipments amounted to 52,633,983 net tons vs. 53,657,363 in the same period last year.

Principal product shipments in August and the first eight months follow:

Steel Product Shipments—August
(Net tons)

C.R. Sheets	994,343	19.6 per cent
H.R. Sheets	506,275	10.0 per cent
Tin Plate-electrolytic	472,209	9.3 per cent
H.R. Bars	453,252	8.9 per cent
Plates	369,884	7.3 per cent

Steel Product Shipments—8 Months
(Net tons)

C.R. Sheets	10,670,630	20.2 per cent
H.R. Sheets	5,887,836	11.2 per cent
Tin Plate-electrolytic	3,924,544	7.5 per cent
H.R. Bars	5,119,980	9.7 per cent
Plates	4,592,486	8.7 per cent

Shipments to major market classifications from the mills in August and the first eight months were as follows:

Shipments by Markets—August
(Net tons)

Automotive	1,022,412	20.2 per cent
Warehouses	844,449	16.6 per cent
Construction	754,258	14.9 per cent
Containers	567,485	11.2 per cent
Machinery, etc.	246,704	4.9 per cent

Shipments by Markets—8 Months
(Net tons)

Automotive	10,440,849	19.8 per cent
Warehouses	9,392,436	17.9 per cent
Construction	7,059,625	13.4 per cent
Containers	4,989,524	9.5 per cent
Machinery, etc.	3,001,135	5.7 per cent

Space Age Metals Reduced

Price reductions of 10 to 15 per cent on arc-cast molybdenum bars, and about 20 per cent on arc-cast molybdenum plates are announced by the Refractomet Div., Universal-Cyclops Steel Corp., Bridgeville, Pa. The reductions extend to molybdenum 0.5 per cent titanium bars and plates. Arc-cast molybdenum and its alloys are used in meeting the high temperature requirements of Space Age structures.

Plates . . .

Plate Prices, Page 231

While some platemakers say orders are coming in at the best rate in two months, business is still slow and there is little noticeable tightening in delivery promises. Sheared and universal plates can be had within ten days to two weeks in many cases, alloy plates in four to five weeks.

Phoenix Steel Corp. has purchased the Claymont steel plant at

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One new Electric Arc Furnace Charging Bucket Including Bale
Type: Cable Operated—Clamshell
Capacity: 1486 Cu. ft. = 55 tons
Max Dia Closed: 17'-9"
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Claymont, Del., from Colorado Fuel & Iron Corp.

The Phoenix company's Chester blast furnace is 3 miles from Claymont. It will supply hot metal to the Claymont open hearths.

Reports that Phoenix's plate mill at Harrisburg, Pa., would soon be dismantled and sold have been officially denied.

Tank and fabricated pipework is sluggish, and railroad specifications are light. However, shipwork has picked up some, with further gains expected over the rest of this year and into 1961.

Foreign steel is still piling up on the West Coast, and is reported available at prices 10 per cent or more under those quoted by domestic sellers. A Washington State bridge job involving several hundred tons, was to have gone to a foreign company, but delays in awarding the general contract may divert the order to local fabricators.

Tubular Goods . . .

Tubular Goods Prices, Page 235

Bookings of oil country goods in September fell below those in August, in some cases by as much as 20 per cent. Says a leading producer: "When we got to Sept. 1, we didn't have an order for a mill shipment direct to a customer on our books. October may be a little better. At least, we had some tonnage booked at the start of the month."

Customers seem to have only one objective: Inventory liquidation. Having cut their stocks to the point where they're out of balance, they're trading among themselves. Some drillers have reportedly cut the dollar value of their inventories by putting high priced steel in the ground, sacrificing production costs in an effort to make their books look better.

Because they're doing relatively little drilling, major oil producers are buying for immediate needs only from downriver distributors and barge terminals operated by the mills. They feel it's cheaper to pay a 4 per cent premium than to order direct from the mills and carry large stocks. Distributors have cut their inventories too. They're stocking mainly the fast moving items, such as 4½ in. casing, on which they can be sure of getting a markup.

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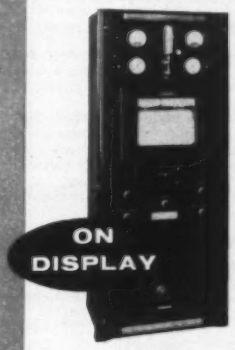

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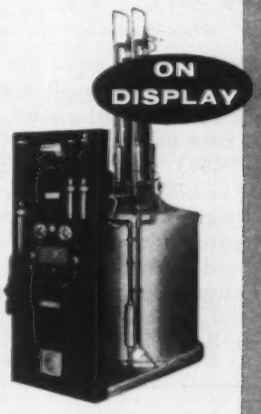

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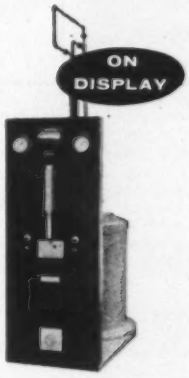

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operation in the U. S. and Canada totaled 1925 in Hughes Tool Co.'s latest weekly count, up two from the preceding week. There were 1782 rigs active in the U. S., down 6, and 143 in Canada, up 8.

Construction by Calnev Pipeline Co. of a 225 mile, petroleum pipeline from Southern California to Las Vegas, Nev., is scheduled to begin this month.

Pig Iron . . .

Pig Iron Prices, Page 236

Trading in merchant iron is slightly more active. Pressure pipemakers are doing fairly well, but requirements of gray iron and steel casting jobbing shops remain light. They're operating less than a full week.

Three blast furnaces at Bethlehem Steel's Lackawanna (N. Y.) Works have been closed down by the strike on the South Buffalo Railway. That leaves only five blast furnaces operating in the Buffalo district.

Iron Ore . . .

Iron Ore Prices, Page 237

Stocks of iron ore in this country and Canada (from all sources) at the end of August totaled 71,977,454 gross tons, up sharply from the 59,484,663 tons held at the same time in 1959. Of the total, 68,901,450 tons were held in the U. S. compared with 56,792,839 tons at the end of August, 1959.

Consumption in August amounted to 7,221,595 gross tons compared with 2,071,988 tons in the same month last year when most of the nation's blast furnaces were closed by the steel strike.

Structural Shapes . . .

Structural Shape Prices, Page 231

Except for highwaywork, structural steel demand is spotty, with fabricators competing strongly for new work. Their order backlogs continue to decline. Shipments of plain material are available within two to four weeks.

Bridge projects offer the most promising outlet at present in the West. A Seattle fabricator has just bid on two sizable jobs in Montana. Yuba Consolidated Industries Inc., San Francisco, and Kaiser Steel Corp., Oakland, Calif., are low bidders for construction of the superstructure of the San Pedro-Terminal Island toll bridge.

STRUCTURAL SHAPES . . .

STRUCTURAL STEEL PLACED

300 tons, Washington State, Mayfield Bridge, to Poole, McGonigle & Dick, Portland, Oreg.; Puget Sound Bridge & Drydock Co., Seattle, general contractor.

146 tons, two state highway bridges, Torrington-Goshen, Conn., to McDermott Steel Specialties Co., North Haven, Conn.; Oneglia & Gervasini Inc., Torrington, Conn., contractor; also required, 80 tons of steel piling, and 43 tons of concrete reinforcing steel bars.

STRUCTURAL STEEL PENDING

834 tons, New England ramp, Morgan Street interchange, Route 84, Hartford, Conn.; also required, 240 tons of concrete reinforcing bars, and 122 tons of steel piles.

650 tons, Public School No. 257, Brooklyn, N. Y.; Caristo Construction Co., Brooklyn, low on general contract.

300 tons, Montana, 558 ft Yellowstone River bridge; W. R. Cahoon, Pocatello, Idaho, low at $280,204.

250 tons, also 57 tons of reinforcing steel, Skagit County, Wash., bridge; Croy Construction Co., Bellingham, Wash., low at $258,433.

170 tons, state highway bridge, Winchester, N. H.; Payne Construction Co., Keene, N. H., general contractor.

147 tons, state bridgework, over Crook Horn thoroughfare, Cape May County, N. J., bids Oct. 27; also required, 352 tons of reinforcing bars.

125 tons, state highway bridge, Route 6, Conway-Bartlett, N. H.; George Brox Co., Dracut, Mass., general contractor.

115 tons, Morse Bridge, Bangor, Maine; bids Oct. 12 to Augusta, Maine.

113 tons, Peltoma Bridge, Pittsfield-Detroit, Maine; bids Oct. 12; also required, 64 tons for a state highway bridge at Rumford, Maine; bids Oct. 12 to Augusta, Maine.

REINFORCING BARS . . .

REINFORCING BARS PLACED

640 tons, Washington State, Mayfield Bridge, to Northwest Steel Rolling Mills Inc., Seattle; Puget Sound Bridge & Drydock Co., Seattle, general contractor.

375 tons, Washington State highway bridge, Cowlitz River, reported placed with Mercer Steel Co., Portland, Oreg.; Hannan Construction Co., Portland, general contractor.

250 tons, Washington State, Biggs Rapids bridge, to Soule Steel Co., Seattle; Paul Jarvis, Seattle, general contractor.

175 tons, women's dormitory, Carroll College, Helena, Mont., to Pacific Coast Div., Bethlehem Steel Co.; Seattle; Waddell Construction Co., Helena, Mont., general contractor, low at $800,000.

REINFORCING BARS PENDING

352 tons, state bridgework, over Crook Horn thoroughfare, Cape May County, N. J., bids Oct. 27; also required, 147 tons of structural steel.

190 tons, two prestressed girder spans, Washington State project, Whatcom County; bids to Olympia, Wash., Oct. 18.

130 tons, stream improvements, Milford, Mass.

120 tons, two Washington State highway projects, Benton and Okanogan Counties; general contracts to Marshall Construction Co., Hermiston, Oreg., and Snitely Bros. Construction Co., Wenatchee, Wash.

110 tons, Roosevelt High School gymnasium, Seattle; General Construction Co., Seattle, low at $505,000.

RAILS, CARS . . .

RAILROAD CARS PLACED

Chicago, Burlington & Quincy, 50 multilevel superstructures for conversion of flatcars to automobile carriers. Orders distributed among ACF Industries Inc., Dana Corp., and Whitehead & Kales.

Union Carbide Plastics Co., eight hundred fifty 50,000 lb shipping containers to Budd Co., Philadelphia.

Trailer Train Co., 1000 piggyback flatcars, to bring the company's total fleet to 5659 units.

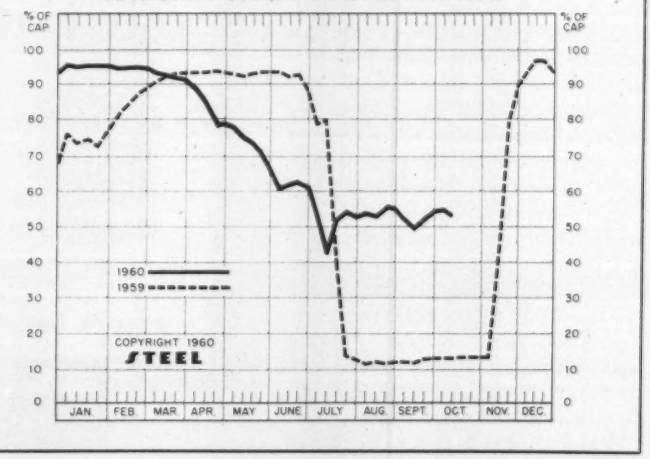
DISTRICT INGOT RATES

(Percentage of capacity utilized)

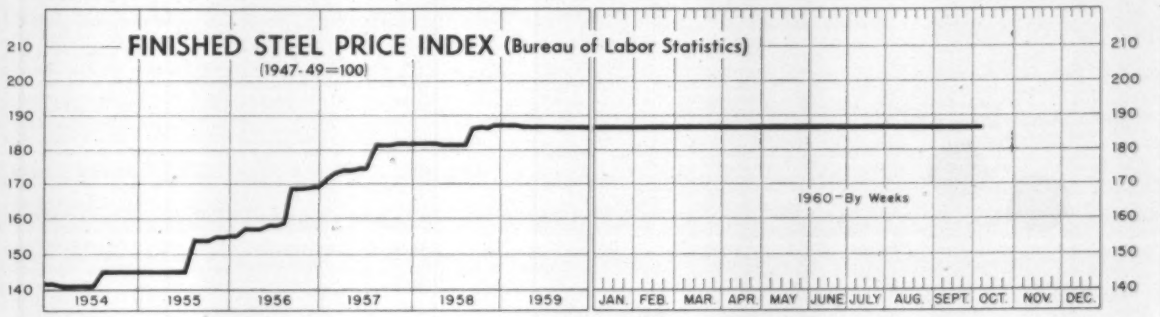
	Week Ended Oct. 9	Week Ago	Month Ago	Year Ago
Northeastern	64	65	53	*
Buffalo	9	42	55	*
Pittsburgh	45	46	38	*
Youngstown	44	46	36	*
Cleveland	59	59	45	*
Detroit	72	67	70	*
Chicago	60	59	58	*
Cincinnati	62	61	53	*
St. Louis	78	79	64	*
Southern	53	49	50	*
Western	48	54	52	*
Total Industry	52.6	54.7	49.2	12.5
Index (1947-49=100)	93.4	97	87.2	22.5
Net Tons (In thousands)	1,500	1,558	1,401	362

Current week's figures are preliminary. Weekly capacity (net tons): 2,849,306 in 1960 and 2,831,331 in 1959. Source: American Iron & Steel Institute. *Not available due to general strike.

NATIONAL STEELWORKS OPERATIONS



Price Indexes and Composites



Oct. 4, 1960	Week Ago	Month Ago	Sept. Index	Year Ago
186.2	186.2	186.2	186.2	186.8

AVERAGE PRICES OF STEEL (Bureau of Labor Statistics)

Week Ended Oct. 4

Prices include mill base prices and typical extras and deductions. Units are 100 lb except where otherwise noted in parentheses. For complete description of the following products and extras and deductions applicable to them, write to STEEL.

Rails, Standard No. 1	$5.825
Rails, Light, 40 lb	7.292
Tie Plates	6.875
Axles, Railway	10.175
Wheels, Freight Car, 33 in. (per wheel)	62.000
Plates, Carbon	6.350
Structural Shapes	6.167
Bars, Tool Steel, Carbon (lb)	0.560
Bars, Tool Steel, Alloy, Oil Hardening Die (lb)	0.680
Bars, Tool Steel, H.R. Alloy, High Speed, W 6.75, Cr 4.5, V 2.1, Mo 5.5, C 0.060 (lb)	1.400
Bars, Tool Steel, H.R. Alloys, High Speed, W18 Cr 4, V 1 (lb)	1.895
Bars, H.R., Alloy	10.775
Bars, H.R., Stainless, 303 (lb)	0.543
Bars, H.R., Carbon	6.675
Bars, Reinforcing	6.335
Bars, C.F., Carbon	10.710
Bars, C.F., Alloy	14.125
Bars, C.F., Stainless, 302 (lb)	0.570
Sheets, H.R., Carbon	6.350
Sheets, C.R., Carbon	7.300
Sheets, Galvanized	8.775
Sheets, C.R., Stainless, 302 (lb)	0.658
Sheets, Electrical	12.625
Strip, C.R., Carbon	9.489
Strip, C.R., Stainless, 430 (lb)	0.480
Strip, H.R., Carbon	6.250
Pipe, Black, Buttweld (100 ft)	19.495
Pipe, Galv., Buttweld (100 ft)	23.098
Pipe, Line (100 ft)	195.430
Casing, Oil Well, Carbon (100 ft)	201.080
Casing, Oil Well, Alloy (100 ft)	315.213
Tubes, Boiler (100 ft)	51.200
Tubing, Mechanical, Carbon (100 ft)	27.005
Tubing, Mechanical, Stainless, 304 (100 ft)	195.395
Tin plate, Hot-dipped, 1.25 lb (95 lb base box)	10.100
Tin Plate, Electrolytic, 0.25 lb (95 lb base box)	8.800
Black Plate, Canmaking Quality (95 lb base box)	7.900
Wire, Drawn, Carbon	10.575
Wire, Drawn, Stainless, 430 (lb)	0.665
Bale Ties (bundles)	7.647
Nails, Wire, 8d Common	9.433
Wire, Barbed (80-rod spool)	8.414
Woven Wire Fence (20-rod roll)	21.008

STEEL's FINISHED STEEL PRICE INDEX

	Oct. 5 1960	Week Ago	Month Ago	Year Ago	5 Yr Ago
Index (1935-39 avg.=100)	247.82	247.82	247.82	247.82	208.90
Index in cents per lb	6.713	6.713	6.713	6.713	5.661

STEEL's ARITHMETICAL PRICE COMPOSITES

Finished Steel, NT	$149.96	$149.96	$149.96	$149.96	$128.14
No. 2 Fdry, Pig Iron, GT	66.49	66.49	66.49	66.49	58.99
Basic Pig Iron, GT	65.99	65.99	65.99	65.99	58.49
Malleable Pig Iron, GT	67.27	67.27	67.27	67.27	59.77
Steelmaking Scrap, GT	30.67	31.33	32.33	43.00	45.23

Comparison of Prices

Comparative prices by districts in cents per pound except as otherwise noted. Delivered prices based on nearest production point.

FINISHED STEEL

	Oct. 5 1960	Week Ago	Month Ago	Year Ago	5 Yr Ago
Bars, H.R., Pittsburgh	5.675	5.675	5.675	5.675	4.65
Bars, H.R., Chicago	5.675	5.675	5.675	5.675	4.65
Bars, H.R., deld., Philadelphia	5.975	5.975	5.975	5.975	4.90
Bars, C.R., Pittsburgh	7.65*	7.65*	7.65*	7.65*	5.90
Shapes, Std., Pittsburgh	5.50	5.50	5.50	5.50	4.60
Shapes, Std., Chicago	5.50	5.50	5.50	5.50	4.60
Shapes, deld., Philadelphia	5.77	5.77	5.77	5.77	4.88
Plates, Pittsburgh	5.30	5.30	5.30	5.30	4.50
Plates, Chicago	5.30	5.30	5.30	5.30	4.50
Plates, Coatesville, Pa.	5.30	5.30	5.30	5.30	4.50
Plates, Sparrows Point, Md.	5.30	5.30	5.30	5.30	4.50
Plates, Claymont, Del.	5.30	5.30	5.80	5.30	4.50
Sheets, H.R., Pittsburgh	5.10	5.10	5.10	5.10	4.325
Sheets, H.R., Chicago	5.10	5.10	5.10	5.10	4.325
Sheets, C.R., Pittsburgh	6.275	6.275	6.275	6.275	5.325
Sheets, C.R., Chicago	6.275	6.275	6.275	6.275	5.325
Sheets, C.R., Detroit	6.275	6.275	6.275	6.275	5.325-5.425
Sheets, Galv., Pittsburgh	6.875	6.875	6.875	6.875	5.85
Strip, H.R., Pittsburgh	5.10	5.10	5.10	5.10	4.325
Strip, H.R., Chicago	5.10	5.10	5.10	5.10	4.325
Strip, C.R., Pittsburgh	7.425	7.425	7.425	7.425	6.25-6.45
Strip, C.R., Chicago	7.425	7.425	7.425	7.425	6.35-6.45
Strip, C.R., Detroit	7.425	7.425	7.425	7.425	6.35
Wire, Basic, Pittsburgh	8.00	8.00	8.00	8.00	6.25
Nails, Wire, nonstock, Pitts.	8.95	8.95	8.95	8.95	7.60
Tin Plate (1.50 lb) box, Pitts.	$10.65	$10.65	$10.65	$10.65	$9.45

*Including 0.35c for special quality.

SEMIFINISHED STEEL

Billets, forging, Pitts. (NT)	$99.50	$99.50	$99.50	$99.50	$84.50
Wire rods, 7/32-9/16" Pitts.	6.40	6.40	6.40	6.40	5.025

PIG IRON, Gross Ton

	Oct. 5 1960	Week Ago	Month Ago	Year Ago	5 Yr Ago
Bessemer, Pittsburgh	$67.00	$67.00	$67.00	$67.00	$59.50
Basic, Valley	66.00	66.00	66.00	66.00	58.50
Basic, deld., Philadelphia	70.41	70.41	70.41	70.41	59.16
No. 2 Fdry, NevilleIsland, Pa.	66.50	66.50	66.50	66.50	59.00
No. 2 Fdry, Chicago	66.50	66.50	66.50	66.50	59.00
No. 2 Fdry, deld., Phila.	70.91	70.91	70.91	70.91	59.66
No. 2 Fdry, Birmingham	62.50	62.50	62.50	62.50	55.00
No. 2 Fdry (Birm.), deld., Cin.	70.20	70.20	70.20	70.20	62.70
Malleable, Valley	66.50	66.50	66.50	66.50	59.00
Malleable, Chicago	66.50	66.50	66.50	66.50	59.00
Ferromanganese, net tonst.	245.00	245.00	245.00	245.00	190.00

†74-76% Mn, Duquesne, Pa.

SCRAP, Gross Ton (Including broker's commission)

No. 1 Heavy Melt, Pittsburgh	$28.50	$30.50	$30.50	$44.50	$44.50
No. 1 Heavy Melt, E. Pa.	35.00	35.00	35.00	44.00	46.50
No. 1 Heavy Melt, Chicago	28.50	28.50	31.50	40.50	45.00
No. 1 Heavy Melt, Valley	30.50	31.50	33.50	44.50	48.00
No. 1 Heavy Melt, Cleve.	28.50	29.50	31.50	41.50	44.50
No. 1 Heavy Melt, Buffalo	27.50	29.50	29.50	33.50	38.50
Rails, Rerolling, Chicago	52.50	52.50	53.50	64.50	65.50
No. 1 Cast, Chicago	38.50	38.50	40.50	56.50	48.50

COKE, Net Ton

Beehive, Furn., Connlsvl.	$15.00	$15.00	$15.00	$15.00	$13.625
Beehive, Fdry., Connlsvl.	18.25	18.25	18.25	18.25	16.50
Oven, Fdry., Milwaukee	32.00	32.00	32.00	32.00	26.25

• specify • specify

set
your line
with extra
sales bait

TI-CO® NON-FLAKING GALVANIZED SHEETS

for DURABILITY

Tough, strong, corrosion-resistant . . . that's Inland TI-CO . . . the non-flaking galvanized sheet with the rugged coating plus the inherent strength of steel. ■ Easy formability, too. Deep-draw, spin, punch, crimp, Pittsburgh lock-seam—work TI-CO to the very limit of the base metal—and you'll never have a chipping, peeling, cracking or flaking problem. ■ That's why manufacturers of products calling for endurance under roughest treatment—buildings, conveyors, chutes, siding, highway guard rails—use TI-CO to add "sales bait" to their product line.

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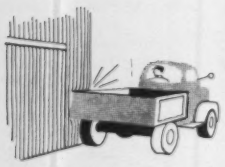
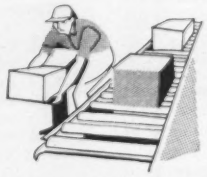
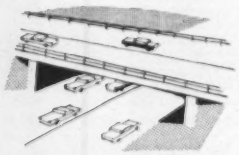
INLAND



Farm buildings made from non-flaking TI-CO maintain corrosion-resisting coating under toughest abuse.



Though subjected to constant abrasive action, TI-CO adds years of service to this roller conveyor.



Denting, scratching, weathering won't stop the protection of highway guard rails afforded by TI-CO.

Steel Prices

Mill prices as reported to STEEL, Oct. 5, cents per pound except as otherwise noted. *Changes shown in italics.* Code number following mill point indicates producing company. Key to producers, page 232; footnotes, page 234.

SEMIFINISHED

INGOTS, Carbon, Forging (NT)
Munhall,Pa. U5 .....$76.00

INGOTS, Alloy NT)
Detroit S41 .....$82.00
Economy,Pa. B14 .....82.00
Farrell,Pa. S3 .....82.00
Lowellville,O. S3 .....82.00
Midland,Pa. C18 .....82.00
Munhall,Pa. U5 .....82.00
Sharon,Pa. S3 .....82.00

BILLETS, BLOOMS & SLABS Carbon Rerolling (NT)
Bartonville,Ill. K4 ....$82.00
Bessemer,Pa. U5 .....80.00
Buffalo R2 .....80.00
Clairton,Pa. U5 .....80.00
Ensley,Ala. T2 .....80.00
Fairfield,Ala. T2 .....80.00
Fontana,Calif. K1 ....80.00
Gary,Ind. U5 .....80.00
Johnstown,Pa. B2 .....80.00
Lackawanna,N.Y. B2 ..80.00
Munhall,Pa. U5 .....80.00
Owensboro,Ky. G8 ....80.00
S.Chicago,Ill. R2, U5 ..80.00
S.Duquesne,Pa. U5 ....80.00
Sterling,Ill. N15 .....80.00
Youngstown R2 .....80.00

Carbon, Forging (NT)
Bessemer,Pa. U5 ....$99.50
Buffalo R2 .....99.50
Canton,O. R2 .....102.00
Clairton,Pa. U5 .....99.50
Conshohocken,Pa. A3..104.50
Ensley,Ala. T2 .....99.50
Fairfield,Ala. T2 .....99.50
Farrell,Pa. S3 .....99.50
Fontana,Calif. K1 ....109.00
Gary,Ind. U5 .....99.50
Geneva,Utah C11 .....99.50
Houston S5 .....104.50
Johnstown,Pa. B2 .....99.50
Lackawanna,N.Y. B2 ..99.50
LosAngeles B3 .....109.00
Midland,Pa. C18 .....99.50
Munhall,Pa. U5 .....99.50
Owensboro,Ky. G8 ....99.50
Seattle B3 .....109.00
Sharon,Pa. S3 .....99.50
S.Chicago R2, U5, W14..99.50
S.Duquesne,Pa. U5 ....99.50
S.SanFrancisco B3 ..109.00
Warren,O C17 .....99.50

Alloy, Forging (NT)
Bethlehem,Pa. B2 ..$119.00
Bridgeport,Conn. C32..119.00
Buffalo R2 .....119.00
Canton,O. R2, T7 ....119.00
Conshohocken,Pa. A3 .126.00
Detroit S41 .....119.00
Economy,Pa. B14 ....119.00
Farrell,Pa. S3 .....119.00
Fontana,Calif. K1 ....140.00
Gary,Ind. U5 .....119.00
Houston S5 .....124.00
Ind.Harbor,Ind. Y1 ...119.00
Johnstown,Pa. B2 ....119.00
Lackawanna,N.Y. B2..119.00
LosAngeles B3 .....139.00
Lowellville,O. S3 ....119.00
Massillon,O. R2 .....119.00
Midland,Pa. C18 .....119.00
Munhall,Pa. U5 .....119.00
Owensboro,Ky. G8 ....119.00
Seattle(6) B3 .....140.00
Sharon,Pa. S3 .....119.00
S.Chicago R2,U5,W14..119.00
S.Duquesne,Pa. U5 ...119.00
Struthers,O. Y1 .....119.00
Warren,O. C17 .....119.00

ROUNDS, SEAMLESS TUBE NT)
Buffalo R2 .....$122.50
Canton,O. R2 .....125.00
Cleveland R2 .....122.50
Gary,Ind. U5 .....122.50
S.Chicago,Ill. R2,W14..122.50
S.Duquesne,Pa. U5 ....122.50
Warren,O. C17 .....122.50

SKELP
Aliquippa,Pa. J5 .....5.05
Benwood,W.Va. W10 ...5.05
Ind.Harbor,Ind. Y1 ....5.05
Munhall,Pa. U5 .....5.05
Pittsburgh J5 .....5.05
Warren,O. R2 .....5.05
Youngstown R2, U5 ....5.05

WIRE RODS
AlabamaCity,Ala. R2 ..6.40
Aliquippa,Pa. J5 .....6.40
Alton,Ill. L1 .....6.60
Bartonville,Ill. K4 ....6.50
Buffalo W12 .....6.40
Cleveland A7 .....6.40
Donora,Pa. A7 .....6.40
Fairfield,Ala. T2 .....6.40
Houston S5 .....6.65
IndianaHarbor,Ind. Y1 ..6.40
Johnstown,Pa. B2 ....6.40
Joliet,Ill. A7 .....6.40
KansasCity,Mo. S5 ....6.65
Kokomo,Ind. C16 .....6.50
LosAngeles B3 .....7.20
Minnequa,Colo. C10 ....6.65
Monessen,Pa. P7 .....6.40
Pittsburg,Calif. C11 ...7.20
Portsmouth,O. P12 ....6.40
Roebling,N.J. R5 .....6.50
S.Chicago,Ill. R2, W14..6.40
SparrowsPoint,Md. B2 ..6.50
Sterling,Ill.(1) N15 ....6.40
Sterling,Ill. N15 .....6.50
Struthers,O. Y1 .....6.40
Worcester,Mass. A7 ....6.70

STRUCTURALS

Carbon Steel Std. Shapes
AlabamaCity,Ala. R2 ...5.50
Aliquippa,Pa. J5 .....5.50
Atlanta A11 .....5.70
Bessemer,Ala. T2 .....5.50
Bethlehem,Pa. B2 .....5.55
Birmingham C15 .....5.50
Clairton,Pa. U5 .....5.50
Fairfield,Ala. T2 .....5.50
Fontana,Calif. K1 .....6.30
Gary,Ind. U5 .....5.50
Geneva,Utah C11 .....5.50
Houston S5 .....5.80
Ind.Harbor,Ind. I-2, Y1 .5.50
Johnstown,Pa. B2 .....5.55
Joliet,Ill. P22 .....5.50
KansasCity,Mo. S5 ....5.60
Lackawanna,N.Y. B2 ...5.55
LosAngeles B3 .....6.20
Minnequa,Colo. C10 ....5.80
Munhall,Pa. U5 .....5.50
Niles,Calif. P1 .....6.25
Phoenixville,Pa. P4 ....5.55
Portland,Oreg. O4 .....6.25
Seattle B3 .....6.25
S.Chicago,Ill. U5, W14 .5.50
S.SanFrancisco B3 ....6.15
Sterling,Ill. N15 .....5.50
Torrance,Calif. C11 ....6.20
Weirton,W.Va. W6 .....5.50

Wide Flange
Bethlehem,Pa. B2 .....5.55
Clairton,Pa. U5 .....5.50
Fontana,Calif. K1 .....6.45
IndianaHarbor,Ind. I-2..5.50
Lackawanna,N.Y. B2 ...5.55
Munhall,Pa. U5 .....5.50
Phoenixville,Pa. P4 ....5.55
S.Chicago,Ill. U5 .....5.50
Sterling,Ill. N15 .....5.50
Weirton,W.Va. W6 ....5.50

Alloy Std. Shapes
Aliquippa,Pa. J5 .....6.80
Clairton,Pa. U5 .....6.80
Gary,Ind. U5 .....6.80
Houston S5 .....6.90
Munhall,Pa. U5 .....6.80
S.Chicago,Ill. U5, W14..6.80

H.S., L.A., Std. Shapes
Aliquippa,Pa. J5 .....8.05
Bessemer,Ala. T2 .....8.05
Bethlehem,Pa. B2 .....8.10
Clairton,Pa. U5 .....8.05
Fairfield,Ala. T2 .....8.05
Fontana,Calif. K1 .....8.85
Gary,Ind. U5 .....8.05
Geneva,Utah C11 .....8.05
Houston S5 .....8.15
Ind.Harbor,Ind. I-2, Y1.8.05
Johnstown,Pa. B2 .....8.10
KansasCity,Mo. S5 ....8.15
Lackawanna,N.Y. B2 ..8.10
LosAngeles B3 .....8.75
Munhall,Pa. U5 .....8.05
Seattle B3 .....8.80
S.Chicago,Ill. U5, W14..8.05
S.SanFrancisco B3 ....8.70
Sterling,Ill. N15 .....7.75
Struthers,O. Y1 .....8.05

H.S., L.A., Wide Flange
Bethlehem,Pa. B2 .....8.10
Ind.Harbor,Ind. I-2 ...8.05
Lackawanna,N.Y. B2 ...8.10
Munhall,Pa. U5 .....8.05
S.Chicago,Ill. U5 .....8.05
Sterling,Ill. N15 .....7.75

PILING

BEARING PILES
Bethlehem,Pa. B2 .....5.55
Ind.Harbor,Ind. I-2 ....5.50
Lackawanna,N.Y. B2 ...5.55
Munhall,Pa. U5 .....5.50
S.Chicago,Ill. .I-2, U5 ..5.50

STEEL SHEET PILING
Ind.Harbor,Ind I-2 ....6.50
Lackawanna,N.Y. B2 ...6.50
Munhall,Pa. U5 .....6.50
S.Chicago,Ill. I-2, U5 ..6.50
Weirton,W.Va. W6 .....6.50

PLATES

PLATES, Carbon Steel
AlabamaCity,Ala. R2 ..5.30
Aliquippa,Pa. J5 .....5.30
Ashland,Ky.(15) A10 ...5.30
Atlanta A11 .....5.50
Bessemer,Ala. T2 .....5.30
Clairton,Pa. U5 .....5.30
Claymont,Del. C22 .....5.30
Cleveland J5, R2 .....5.30
Coatesville,Pa. L7 .....5.30
Conshohocken,Pa. A3 ..5.30
Ecorse,Mich. G5 .....5.30
Fairfield Ala. T2 .....5.30
Farrell,Pa. S3 .....5.30
Fontana,Calif.(30) K1 ..6.10
Gary,Ind. U5 .....5.30
Geneva,Utah C11 .....5.30
GraniteCity,Ill. G4 ....5.40
Harrisburg,Pa. P4 .....5.30
Houston S5 .....5.40
Ind.Harbor,Ind. I-2, Y1.5.30
Johnstown,Pa. B2 .....5.30
Lackawanna,N.Y. B2 ...5.30
Mansfield,O. E6 .....5.30
Minnequa,Colo. C10 ....6.15
Munhall,Pa. U5 .....5.30
Newport,Ky. A2 .....5.30
Pittsburgh J5 .....5.30
Riverdale,Ill. A1 .....5.30
Seattle B3 .....6.20
Sharon,Pa. S3 .....5.30
S.Chicago,Ill. U5, W14 .5.30
SparrowsPoint,Md. B2 ..5.30
Sterling,Ill. N15 .....5.30
Steubenville,O. W10 ....5.30
Warren,O. R2 .....5.30
Youngstown U5, Y1 ....5.30
Youngstown(27) R2 .....5.30

PLATES, Carbon Abras. Resist.
Claymont,Del. C22 .....7.05
Fontana,Calif. K1 .....7.85
Geneva,Utah C11 .....7.05
Houston S5 .....7.15
Johnstown,Pa. B2 .....7.05
SparrowsPoint,Md. B2 ..7.05

PLATES, Wrought Iron
Economy,Pa. B14 .....14.10

PLATES, H.S., L.A.
Aliquippa,Pa. J5 .....7.95
Ashland,Ky. A10 .....7.95
Bessemer,Ala. T2 .....7.95
Clairton,Pa. U5 .....7.95
Claymont,Del. C22 .....7.95
Cleveland J5 , R2 .....7.95
Coatesville,Pa. L7 .....7.95
Conshohocken,Pa. A3 ..7.95
Economy,Pa. B14 .....7.95
Ecorse,Mich. G5 .....7.95
Fairfield,Ala. T2 .....7.95
Farrell,Pa. S3 .....7.95
Fontana,Calif.(30) K1 ..8.75
Gary,Ind. U5 .....7.95
Geneva,Utah C11 .....7.95
Houston S5 .....8.05
Ind.Harbor,Ind. I-2, Y1.7.95
Johnstown,Pa. B2 .....7.95
Munhall,Pa. U5 .....7.95
Pittsburgh J5 .....7.95
Seattle B3 .....8.85
Sharon,Pa. S3 .....7.95
S.Chicago,Ill. U5, W14..7.95
SparrowsPoint,Md. B2 ..7.95
Sterling,Ill. N15 .....7.625
Warren,O. R2 .....7.95
Youngstown U5, Y1 ....7.95

PLATES, Alloy
Aliquippa,Pa. J5 .....7.50
Claymont,Del. C22 .....7.50
Coatesville,Pa. L7 .....7.50
Economy,Pa. B14 .....7.50
Farrell,Pa. S3 .....7.50
Fontana,Calif. K1 .....8.30
Gary,Ind. U5 .....7.50
Houston S5 .....7.60
Ind Harbor,Ind. Y1 ....7.50
Johnstown,Pa. B2 .....7.50
Lowellville,O. S3 .....7.50
Munhall,Pa. U5 .....7.50
Newport,Pa. A2 .....7.50
Pittsburgh J5 .....7.50
Seattle B3 .....8.40
Sharon,Pa. S3 .....7.50
S.Chicago,Ill. U5, W14..7.50
SparrowsPoint Md. B2 ..7.50
Youngstown Y1 .....7.50

FLOOR PLATES
Cleveland J5 .....6.375
Conshohocken,Pa. A3 ..6.375
Ind.Harbor,Ind. I-2 ....6.375
Munhall,Pa. U5 .....6.375
Pittsburgh J5 .....6.375
S.Chicago,Ill. U5 .....6.375

PLATES, Ingot Iron
Ashland c.l.(15) A10 ...5.55
Ashland l.c.l.(15) A10 ..6.05
Cleveland c.l. R2 .....6.05
Warren,O. R2 .....6.05

BARS

BARS, Hot-Rolled Carbon (Merchant Quality)
Ala.City,Ala.(9) R2 ...5.675
Aliquippa,Pa.(9) J5 ...5.675
Alton,Ill. L1 .....5.875
Atlanta(9) A11 .....5.875
Bessemer,Ala.(9) T2 ...5.675
Birmingham(9) C15 ...5.675
Buffalo(9) R2 .....5.675
Canton,O.(23) R2 .....6.15
Clairton,Pa.(9) U5 ....5.675
Cleveland(9) R2 .....5.675
Ecorse,Mich.(9) G5 ....5.675
Emeryville,Calif. J7 ...6.425
Fairfield,Ala.(9) T2 ...5.675
Fairless,Pa.(9) U5 ....5.825
Fontana,Calif.(9) K1 ...6.375
Gary,Ind.(9) U5 .....5.675
Houston(9) S5 .....5.925
Ind.Harbor(9) I-2, Y1..5.675
Johnstown,Pa.(9) B2 ...5.675
Joliet,Ill. P2 .....5.675
KansasCity,Mo.(9) S5..5.925
Lackawanna(9) B2 ....5.675
LosAngeles(9) B3 .....6.375
Massillon,O.(23) R2 ....6.15
Midland,Pa.(23) C18 ...6.025
Milton,Pa. M18 .....5.825
Minnequa,Colo. C10 ....6.125
Niles,Calif. P1 .....6.375
Owensboro,Ky.(9) G8 ...6.025
Pittsburg,Calif.(9) C11..6.375
Pittsburgh(9) J5 .....5.675
Portland,Oreg. O4 .....6.425
Riverdale,Ill.(9) A1 ...5.675
Seattle(9) A24,B3,N15 .6.425
S.Ch'e'go(9)R2,U5,W14 .5.675
S.Duquesne,Pa.(9) U5..5.675
S.SanFran.,Calif.(9)B3 .6.425
Sterling,Ill.(1)(9) N15..5.675
Sterling,Ill.(9) N15 ....5.775
Struthers,O.(9) Y1 .....5.675
Tonawanda,N.Y. B12 ....5.675
Torrance,Calif.(9) C11 .6.375
Warren,O. C17 .....6.025
Youngstown(9) R2,U5..5.675

BARS, Hot-Rolled Alloy
Aliquippa,Pa. J5 .....6.725
Bethlehem,Pa. B2 .....6.725
Bridgeport,Conn. C32 ..6.80
Buffalo R2 .....6.725
Canton,O. R2, T7 .....6.725
Clairton,Pa. U5 .....6.725
Detroit S41 .....6.725
Economy,Pa. B14 .....6.725
Ecorse,Mich. G5 .....6.725
Fairless,Pa. U5 .....6.875
Farrell,Pa. S3 .....6.725
Fontana,Calif. K1 .....7.775
Gary,Ind. U5 .....6.725
Houston S5 .....6.975
Ind.Harbor,Ind. I-2, Y1 6.725
Johnstown,Pa. B2 .....6.725
KansasCity,Mo. S5 ....6.975
Lackawanna,N.Y. B2 ...6.725
LosAngeles B3 .....7.775
Lowellville,O. S3 .....6.725
Massillon,O. R2 .....6.725
Midland,Pa. C18 .....6.725
Owensboro,Ky. G8 ....6.725
Pittsburgh J5 .....6.725
Seattle(6) B3 .....7.825
Sharon,Pa. S3 .....6.725
S.Chicago R2, U5, W14.6.725
S.Duquesne,Pa. U5 ....6.725
Struthers,O. Y1 .....6.725
Warren,O. C17 .....6.725
Youngstown U5 .....6.725

BARS & SMALL SHAPES, H.R. High-Strength, Low-Alloy
Aliquippa,Pa. J5 .....8.30
Bessemer,Ala. T2 .....8.30
Bethlehem,Pa. B2 .....8.30
Clairton,Pa. U5 .....8.30
Cleveland R2 .....8.30
Ecorse,Mich. G5 .....8.30
Fairfield,Ala. T2 .....8.30
Fontana,Calif. K1 .....9.00
Gary,Ind. U5 .....8.30
Houston S5 .....8.55
Ind.Harbor,Ind. Y1 ....8.30
Johnstown,Pa. B2 .....8.30
KansasCity,Mo. S5 ....8.55
Lackawanna,N.Y. B2 ...8.30
LosAngeles B3 .....9.00
Pittsburgh J5 .....8.30
Seattle B3 .....9.05
S.Chicago,Ill. R2, W14..8.30
S.Duquesne,Pa. U5 ....8.30
S.SanFrancisco B3 .....9.05
Sterling,Ill. N15 .....7.925
Struthers,O. Y1 .....8.30
Youngstown U5 .....8.30

BAR SIZE ANGLES; H.R. Carbon
Bethlehem,Pa.(9) B2 ...5.825
Houston(9) S5 .....5.925
KansasCity,Mo.(9) S5..5.925
Lackawanna(9) B2 ....5.675
Sterling,Ill. N15 .....5.775
Sterling,Ill.(1) N15 ....5.675
Tonawanda,N.Y. B12 ..5.675

BAR SIZE ANGLES; S. SHAPES Wrought Iron
Aliquippa,Pa. J5 .....5.675
Atlanta A11 .....5.875
Joliet,Ill. P22 .....5.675
Minnequa,Colo. C10 ....6.125
Niles,Calif. P1 .....6.375
Pittsburgh J5 .....5.675
Portland,Oreg. O4 .....6.425
SanFrancisco S7 .....6.52
Seattle B3 .....6.425

BAR SIZE ANGLES; S. SHAPES Wrought Iron
Economy,Pa. B14 .....16.45

BAR SHAPES, Hot-Rolled Alloy
Aliquippa,Pa. J5 .....6.80
Clairton,Pa. U5 .....6.80
Gary,Ind. U5 .....6.80
Houston S5 .....7.05
KansasCity,Mo. S5 .....7.05
Pittsburgh J5 .....6.80
Youngstown U5 .....6.80

BARS, C.F. Loaded (Including loaded extra)
Carbon
LosAngeles P2 S30 ..11.75*
Alloy
Ambridge,Pa. W18 ...10.175
BeaverFalls,Pa. M12..10.175
Camden,N.J. P13 .....10.35
Chicago W18 .....10.175
Elyria,O. W8 .....10.175
Monaca,Pa. S17 .....10.175
Newark,N.J. W18 .....10.35
SpringCity,Pa. K3 .....10.35

*Grade A; add 0.5c for Grade B.

BARS, Cold-Finished Carbon
Ambridge,Pa. W18 .....7.65
BeaverFalls,Pa. M12,R2..7.65
Birmingham C15 .....8.25
Buffalo B5 .....7.70
Camden,N.J. P13 .....8.10
Carnegie,Pa. C12 .....7.65
Chicago W18 .....7.65
Cleveland A7, C20 .....7.65
Detroit B5, P17 .....7.85
Detroit S41 .....7.65
Donora,Pa. A7 .....7.65
Elyria,O. W8 .....7.65
FranklinPark,Ill. N5 ....7.65
Gary,Ind. R2 .....7.65
GreenBay,Wis. F7 .....7.65
Hammond,Ind. J5, L2. .7.65
Hartford,Conn. R2 .....8.15
Harvey,Ill. B5 .....7.65
LosAngeles(49) S30 ....9.10
LosAngeles(49) P2, R2. .9.10
Mansfield,Mass. B5 ....8.20
Massillon,O. R2, R8 ....7.65
Midland,Pa. C18 .....7.65
Monaca,Pa. S17 .....7.65
Newark,N.J. W18 .....8.10
NewCastle,Pa.(17) B4 ..7.65
Pittsburgh J5 .....7.65
Plymouth,Mich. P5 .....7.90
Putnam,Conn. W18 .....8.20
Readville,Mass. C14 ....8.20
Seattle(49) S30 .....9.10
S.Chicago,Ill. W14 .....7.65
SpringCity,Pa. K3 .....8.10
Struthers,O. Y1 .....7.65
Warren,O. C17 .....7.65
Waukegan,Ill. A7 .....7.65
Willimantic,Conn. J5 ...8.15
Youngstown F3, Y1 ....7.65

BARS, Cold-Finished Carbon (Turned and Ground)
Cumberland,Md.(5) C19..6.55

BARS, Cold-Finished Alloy
Ambridge,Pa. W18 .....9.025
BeaverFalls,Pa. M12,R2 .9.025
Bethlehem,Pa. B2 .....9.025
Bridgeport,Conn. C32 ..9.175
Buffalo B5 .....9.025
Camden,N.J. P13 .....9.20
Canton,O. T7 .....9.025
Carnegie,Pa. C12 .....9.025
Chicago W18 .....9.025
Cleveland A7, C20 .....9.025
Detroit B5, P17 .....9.225
Detroit S41 .....9.025
Donora,Pa. A7 .....9.025
Elyria,O. W8 .....9.025
FranklinPark,Ill. N5 ...9.025
Gary,Ind. R2 .....9.025
GreenBay,Wis. F7 .....9.025
Hammond,Ind. J5, L2. .9.025
Hartford,Conn. R2 .....9.325
Harvey,Ill. R5 .....9.025
Lackawanna,N.Y. B3..9.025
LosAngeles P2, S30 ...11.00
Mansfield,Mass. B5 ....9.325
Massillon,O. R2, R8 ....9.025
Midland,Pa. C18 .....9.025
Monaca,Pa. S17 .....9.025
Newark,N.J. W18 .....9.20
Plymouth,Mich. P5 .....9.225
S.Chicago,Ill. W14 .....9.025
SpringCity,Pa. K3 .....9.20
Struthers,O. Y1 .....9.025

Warren,O. C17 .....9.025
Waukegan,Ill. A7 ....9.025
Willimantic,Conn. J5 ..9.325
Worcester,Mass. A7 ...9.325
Youngstown F3, Y1 ...9.025

BARS, Reinforcing, Billet (To Fabricators)

AlabamaCity,Ala. R2 ..5.675
Atlanta A11 .....5.25
Birmingham C15 .....5.25
Buffalo R2 .....5.675
Cleveland R2 .....5.675
Ecorse,Mich. G5 .....5.675
Emeryville,Calif. J7 ...6.425
Fairfield,Ala. T2 .....5.675
Fairless,Pa. U5 .....5.825
Fontana,Calif. K1 ....6.375
Ft. Worth,Tex.(26) T4 ..5.50
Gary,Ind. U5 .....5.675
Houston S5 .....5.675
Ind.Harbor,Ind. I-2,Y1.5.675
Johnstown,Pa. B2 ....5.675
Joliet,Ill. P22 .....5.675
KansasCity,Mo. S5 ...5.675
Kokomo,Ind. C16 ....5.775
Lackawanna,N.Y. B2..5.675
LosAngeles B3 .....6.375
Madison,Ill. L1 .....5.875
Milton,Pa. M18 .....5.825
Minnequa,Colo. C10 ...6.125
Niles,Calif. P1 .....6.375
Pittsburg,Calif. C11 ..6.375
Pittsburgh J5 .....5.675
Portland,Oreg. O4 ....6.425
SandSprings,Okla. S5 ..5.675
Seattle A24, B3, N14...6.425
S.Chicago,Ill. R2, W14.5.675
S.Duquesne,Pa. U5 ....5.675
S.SanFrancisco B3 ....6.425
SparrowsPoint,Md. B2..5.675
Sterling,Ill.(1) N15 ...5.675
Sterling,Ill. N15 .....5.775
Struthers O. Y1 .....5.675
Tonawanda,N.Y. B12 ..6.10
Torrance,Calif. C11 ...6.375
Youngstown R2, U5 ..5.675

BARS, Reinforcing, Billet (Fabricated: To Consumers)

Baltimore B2 .....7.42
Boston B2, U8 .....8.15
Chicago U8 .....7.41
Cleveland U8 .....7.39
Houston S5 .....7.35
Johnstown,Pa. B2 ....7.33
KansasCity,Mo. S5 ....7.35
Lackawanna,N.Y. B2 ..7.35
Marion,O. P11 .....6.70
Newark,N.J U8 .....7.80
Philadelphia U8 .....7.63
Pittsburgh J5, U8 ....7.35
SandSprings,Okla. S5 ...7.35
Seattle A24, B3, N14 ..7.95
SparrowsPoint,Md. B2 ..7.33
St.Paul U8 .....8.17
Williamsport,Pa. S19 ..7.25

BARS, Wrought Iron

Economy,Pa.(S.R.)B14 15.10
Economy,Pa.(D.R.)B14 19.30
Econ.(DirectRolled)B14 13.55
Economy(Staybolt)B14 19.80
McK.Rks.(S.R.) L5 ...14.50
McK.Rks.(D.R.) L5 ...19.80
McK.Rks.(Staybolt)L5. 20.95

BARS, Rail Steel

ChicagoHts.(3) C2, I-2.5.575
ChicagoHts.(4)(44) I-2.5.675
ChicagoHts.(4) C2 ....5.675
Franklin,Pa.(3) F5 ....5.575
Franklin,Pa.(4) F5 ....5.675
JerseyShore,Pa.(3) J8 .5.55
Marion,O.(3) P11 .....5.575
Tonawanda(3) B12 ....5.575
Tonawanda(4) B12 ....6.10

SHEETS

SHEETS, Hot-Rolled Steel (18 Gage and Heavier)

AlabamaCity,Ala. R2 ..5.10
Allenport,Pa. P7 .....5.10
Aliquippa,Pa. J5 .....5.10
Ashland,Ky.(8) A10 ....5.10
Cleveland J5, R2 .....5.10
Conshohocken,Pa. A3 ..5.15
Detroit(8) M1 .....5.10
Ecorse,Mich. G5 .....5.10
Fairfield,Ala. T2 .....5.10
Fairless,Pa. U5 .....5.15
Farrell,Pa. S3 .....5.10
Fontana,Calif. K1 ....5.825
Gary,Ind. U5 .....5.10
Geneva,Utah C11 .....5.20
GraniteCity,Ill.(8) G4 ..5.20
Ind.Harbor,Ind. I-2, Y1.5.10
Irvin,Pa. U5 .....5.10
Lackawanna,N.Y. B2 ..5.10
Mansfield,O. E6 .....5.10
Munhall,Pa. U5 .....5.10
Newport,Ky. A2 .....5.10
Niles,O. M21, S3 .....5.10
Pittsburg,Calif. C11 ....5.80
Pittsburgh J5 .....5.10
Portsmouth,O. P12 .....5.10
Riverdale,Ill. A1 .....5.10
Sharon,Pa. S8 .....5.10
S.Chicago,Ill. U5, W14..5.10
SparrowsPoint,Md. B2 ..5.10
Steubenville,O. W10 ....5.10
Warren,O. R2 .....5.10
Weirton,W.Va. W6 ....5.10
Youngstown U5, Y1 ....5.10

SHEETS, H.R. (19 Ga. & Lighter)

Niles,O. M21. S3 ....6.275

SHEETS, H.R. Alloy

Gary,Ind. U5 .....8.40
Ind.Harbor,Ind. Y1 ....8.40
Irvin,Pa. U5 .....8.40
Munhall,Pa. U5 .....8.40
Newport,Ky. A2 .....8.40
Youngstown U5, Y1 ....8.40

SHEETS, H.R. (14 Ga. & Heavier) High-Strength, Low-Alloy

Aliquippa,Pa. J5 .....7.525
Ashland,Ky. A10 .....7.525
Cleveland J5, R2 .....7.525
Conshohocken,Pa. A3 ..7.575
Ecorse,Mich. G5 .....7.525
Fairfield,Ala. T2 .....7.525
Fairless,Pa. U5 .....7.575
Farrell,Pa. S3 .....7.525
Fontana,Calif. K1 .....8.25
Gary,Ind. U5 .....7.525
Ind.Harbor,Ind. I-2, Y1 7.525
Irvin,Pa. U5 .....7.525
Lackawanna(35) B2 ..7.525
Munhall,Pa. U5 .....7.525
Niles,O. S3 .....7.525
Pittsburgh J5 .....7.525
S.Chicago,Ill. U5, W14.7.525
Sharon,Pa. S3 .....7.525
SparrowsPoint(36) B2..7.525
Warren,O. R2 .....7.525
Weirton,W.Va. W6 ....7.525
Youngstown U5, Y1 ....7.525

SHEETS, Hot-Rolled Ingot Iron (18 Gage and Heavier)

Ashland,Ky.(8) A10 ...5.35
Cleveland R2 .....5.875
Warren,O. R2 .....5.875

SHEETS, Cold-Rolled Ingot Iron

Cleveland R2 .....7.05
Middletown,O. A10 ....6.775
Warren,O. R2 .....7.05

SHEETS, Cold-Rolled Steel (Commercial Quality)

AlabamaCity,Ala. R2 ..6.275
Aliquippa,Pa. J5 .....6.275
Allenport,Pa. P7 .....6.275
Cleveland J5, R2 .....6.275
Conshohocken,Pa. A3 ..6.325
Detroit M1 .....6.275
Ecorse,Mich. G5 .....6.275
Fairfield,Ala. T2 .....6.275
Fairless,Pa. U5 .....6.325
Follansbee,W.Va. F4 ..6.275
Fontana,Calif. K1 .....7.40
Gary,Ind. U5 .....6.275
GraniteCity,Ill. G4 ....6.375
Ind.Harbor,Ind. I-2, Y1 6.275
Irvin,Pa. U5 .....6.275
Lackawanna,N.Y. B2 ..6.275
Mansfield,O. E6 .....6.275
Middletown,O. A10 ....6.275
Newport,Ky. A2 .....6.275
Pittsburg,Calif. C11 ...7.225
Pittsburgh J5 .....6.275
Portsmouth,O. P12 ....6.275
SparrowsPoint,Md. B2..6.275
Steubenville,O. W10 ..6.275
Warren,O. R2 .....6.275
Weirton,W.Va. W6 ....6.275
Yorkville,O. W10 .....6.275
Youngstown Y1 .....6.275

SHEETS, Cold-Rolled, High-Strength, Low-Alloy

Aliquippa,Pa. J5 .....9.275
Cleveland J5, R2 .....9.275
Ecorse,Mich. G5 .....9.275
Fairless,Pa. U5 .....9.325
Fontana,Calif. K1 ....10.40
Gary,Ind. U5 .....9.275
Ind.Harbor,Ind. I-2, Y1 9.275
Lackawanna(38) B2 ..9.275
Pittsburgh J5 .....9.275
SparrowsPoint(33) B2..9.275
Warren,O. R2 .....9.275
Weirton,W.Va. W6 ....9.275
Youngstown Y1 .....9.275

SHEETS, Culvert

	Cu Steel	Cu Fe
Ala.City,Ala. R2	7.225	....
Ashland,Ky. A10	7.225	7.475
Canton,O. R2	7.225	....
Fairfield,Ala. T2	7.225	7.475
Gary,Ind. U5	7.225	7.475
GraniteCity,Ill. G4	7.325	....
Ind.Harbor I-2	7.225	7.475
Irvin,Pa. U5	7.225	7.475
Kokomo,Ind. C16	7.325	....
MartinsFry. W10	7.225	7.475
Pitts.,Calif. C11	7.975	....
Pittsburgh J5	7.225	....
SparrowsPt. B2	7.225	....

SHEETS, Culvert—Pure Iron

Ind.Harbor,Ind. I-2 ....7.475

SHEETS, Galvanized Steel Hot-Dipped

AlabamaCity,Ala. R2. 6.875‡
Ashland,Ky. A10 ....6.875‡
Canton,O. R2 .....6.875‡
Dover,O. E6 .....6.875†
Fairfield,Ala. T2 .....6.875†
Gary,Ind. U5 .....6.875†
GraniteCity,Ill. G4 ....6.975*
Ind.Harbor,Ind. I-2 ..6.875†
Irvin,Pa. U5 .....6.975†
Kokomo,Ind. C16 .....6.975‡
MartinsFerry,O. W10..6.875*
Middletown,O. A10 ..6.875†
Pittsburg,Calif. C11 ..7.625*
Pittsburgh J5 .....6.875†
SparrowsPt.,Md. B2 ..6.875†
Warren,O. R2 .....6.875†
Weirton,W.Va. W6 ..6.875*

*Continuous and noncontinuous. †Continuous. ‡Noncontinuous.

SHEETS, Galvanized High-Strength, Low-Alloy

Irvin,Pa. U5 .....10.125
Pittsburgh J5 .....10.125
SparrowsPt.(39) B2 ..10.025

SHEETS, Galvannealed Steel

Canton,O. R2 .....7.275
Irvin,Pa. U5 .....7.275

SHEETS, Galvanized Ingot Iron (Hot-Dipped Continuous)

Ashland,Ky. A10 ....7.125
Middletown,O. A10 ....7.125

SHEETS, Electrogalvanized

Cleveland(28) R2 .....7.65
Niles,O.(28) R2 .....7.65
Weirton,W.Va. W6 ....7.50
Youngstown J5 .....7.50

SHEETS, Well Casing

Fontana,Calif. K1 .....7.325

SHEETS, Aluminum Coated

Butler,Pa. A10 (type 1) 9.525
Butler,Pa. A10 (type 2) 9.625
Irvin,Pa. U5 (type 1)..9.525

SHEETS, Enameling

Ashland,Ky. A10 .....6.775
Cleveland R2 .....6.775
Fairfield,Ala. T2 .....6.775
Gary,Ind. U5 .....6.775
Ind.Harbor,Ind. I-2, Y1 6.775
Irvin,Pa. U5 .....6.775
Middletown,O. A10 ....6.775
Niles,O. M21, S3 .....6.775
SparrowsPoint,Md. B2..6.775
Youngstown Y1 .....6.775

BLUED STOCK, 29 Gage

Dover,O. E6 .....8.70
Ind.Harbor,Ind. I-2 ....8.70
Mansfield,O. E6 .....8.70
Warren,O. R2 .....8.70
Yorkville,O. W10 .....8.70

SHEETS, Long Terne, Steel (Commercial Quality)

BeechBottom,W.Va.W10 7.225
Gary,Ind. U5 .....7.225
Mansfield,O. E6 .....7.225
Middletown,O. A10 ....7.225
Niles,O. M21, S3 .....7.225
Warren,O. R2 .....7.225
Weirton,W.Va. W6 ....7.225

SHEETS, Long Terne, Ingot Iron

Middletown,O. A10 ....7.625

Key to Producers

A1 Acme Steel Co.
A2 Acme-Newport Steel Co.
A3 Alan Wood Steel Co.
A4 Allegheny Ludlum Steel
A5 Alloy Metal Wire Div., H. K. Porter Co. Inc.
A6 American Shim Steel Co.
A7 American Steel & Wire Div., U. S. Steel Corp.
A8 Anchor Drawn Steel Co.
A9 Angell Nail & Chaplet
A10 Armco Steel Corp.
A11 Atlantic Steel Co.
A24 Alaska Steel Mills Inc.

B1 Babcock & Wilcox
B2 Bethlehem Steel Co.
B3 Bethlehem Steel Co., Pacific Coast Div.
B4 Blair Strip Steel Co.
B5 Bliss & Laughlin Inc.
B8 Braeburn Alloy Steel
B9 Brainard Steel Div., Sharon Steel Corp.
B10 E. & G. Brooke, Wickwire Spencer Steel Div., Colo. Fuel & Iron
B12 Buffalo Steel Corp.
B14 A. M. Byers Co.
B15 J. Bishop & Co.

C1 Calstrip Steel Corp.
C2 Calumet Steel Div., Borg-Warner Corp.
C4 Carpenter Steel Co.
C9 Colonial Steel Co.
C10 Colorado Fuel & Iron
C11 Columbia-Geneva Steel
C12 Columbia Steel & Shaft.
C13 Columbia Tool Steel Co.
C14 Compressed Steel Shaft.
C15 Connors Steel Div., H. K. Porter Co., Inc.
C16 Continental Steel Corp.
C17 Copperweld Steel Co.
C18 Crucible Steel Co.
C19 Cumberland Steel Co.
C20 Cuyahoga Steel & Wire
C22 Claymont Plant, Wickwire Spencer Steel Div., Colo. Fuel & Iron
C23 Charter Wire Inc.
C24 G. O. Carlson Inc.
C32 Carpenter Steel of N.Eng.

D2 Detroit Steel Corp.
D4 Disston Div., H. K. Porter Co. Inc.
D6 Driver-Harris Co.
D7 Dickson Weatherproof Nail Co.
D8 Damascus Tube Co.
D9 Wilbur B. Driver Co.

E1 Eastern Gas&Fuel Assoc.
E2 Eastern Stainless Steel
E6 Empire-Reeves Steel
E10 Enamel Prod. & Plating

F2 Firth Sterling Inc.
F3 Fitzsimmons Steel Co.
F4 Follansbee Steel Corp.
F5 Franklin Steel Div., Borg-Warner Corp.
F6 Fretz-Moon Tube Co.
F7 Ft. Howard Steel & Wire
F8 Ft. Wayne Metals Inc.

G4 Granite City Steel Co.
G5 Great Lakes Steel Corp.
G6 Greer Steel Co.
G8 Green River Steel Corp.

H1 Hanna Furnace Corp.
H7 Helical Tube Co.

I-1 Igoe Bros. Inc.
I-2 Inland Steel Co.
I-3 Interlake Iron Corp.
I-4 Ingersoll Steel Div., Borg-Warner Corp.
I-6 Ivins Steel Tube Works
I-7 Indiana Steel & Wire Co.

J1 Jackson Iron & Steel Co.
J3 Jessop Steel Co.
J4 Johnson Steel & Wire Co.
J5 Jones & Laughlin Steel
J6 Joslyn Mfg. & Supply
J7 Judson Steel Corp.
J8 Jersey Shore Steel Co.

K1 Kaiser Steel Corp.
K2 Keokuk Electro-Metals
K3 Keystone Drawn Steel
K4 Keystone Steel & Wire
K7 Kenmore Metals Corp.

L1 Laclede Steel Co.
L2 LaSalle Steel Co.
L3 Latrobe Steel Co.
L6 Lone Star Steel Co.
L7 Lukens Steel Co.
L8 Leschen Wire Rope Div., H. K. Porter Co. Inc.

M1 McLouth Steel Corp.
M4 Mahoning Valley Steel
M6 Mercer Pipe Div. Sawhill Tubular Products
M8 Mid-States Steel & Wire
M12 Moltrup Steel Products
M14 McInnes Steel Co.
M16 Md. Fine & Specialty Wire Co. Inc.
M17 Metal Forming Corp.
M18 Milton Steel Div. Merritt-Chapman&Scott
M21 Mallory-Sharon Metals Corp
M22 Mill Strip Products Co.
M23 Mill Strip Products Co. of Pennsylvania

N1 National-Standard Co.
N2 National Supply Co.
N3 National Tube Div., U. S. Steel Corp.
N5 Nelsen Steel & Wire Co.
N6 New England High Carbon Wire Co.
N8 Newman-Crosby Steel
N14 Northwest. Steel Rolling Mills Inc.
N15 Northwestern S.&W. Co.
N20 Neville Ferro Alloy Co.

O4 Oregon Steel Mills

P1 Pacific States Steel Corp.
P2 Pacific Tube Co.
P4 Phoenix Steel Corp.
P5 Pilgrim Drawn Steel
P6 Pittsburgh Coke&Chem.
P7 Pittsburgh Steel Co.
P11 Pollak Steel Co.
P12 Portsmouth Div., Detroit Steel Corp.
P13 Precision Drawn Steel
P15 Pittsburgh Metallurgical
P16 Page Steel & Wire Div., American Chain & Cable
P17 Plymouth Steel Corp.
P19 Pitts. Rolling Mills
P20 Prod. Steel Strip Corp.
P22 Phoenix Mfg. Co.
P24 Phil. Steel & Wire Corp.

R2 Republic Steel Corp.
R3 Rhode Island Steel Corp.
R5 Roebling's Sons, John A.
R6 Rome Strip Steel Co.
R8 Reliance Div.,EatonMfg.
R9 Rome Mfg. Co.
R10 Rodney Metals Inc.

S1 Seneca Wire & Mfg. Co.
S3 Sharon Steel Corp.
S4 Sharon Tube Co.
S5 Sheffield Div., Armco Steel Corp.
S6 Shenango Furnace Co.
S7 Simmons Co.
S8 Simonds Saw & Steel Co.
S12 Spencer Wire Corp.
S13 Standard Forgings Corp.
S14 Standard Tube Co.
S15 Stanley Works
S17 Superior Drawn Steel Co.
S18 Superior Steel Div., Copperweld Steel Co.
S19 Sweet's Steel Co.
S20 Southern States Steel
S23 Superior Tube Co.
S25 Stainless Welded Prod.
S26 Specialty Wire Co. Inc.
S30 Sierra Drawn Steel Div., Bliss & Laughlin Inc.
S40 Seneca Steel Service
S41 Stainless & Strip Div., J & L Steel Corp.
S42 Southern Elec. Steel Co.
S43 Seymour Mfg. Co.
S44 Screw & Bolt Corp. of America
S45 Somers Brass Co.

T2 Tenn. Coal & Iron Div., U. S. Steel Corp.
T3 Tenn. Products & Chemical Corp.
T4 Texas Steel Co.
T5 Thomas Strip Div., Pittsburgh Steel Co.
T6 Thompson Wire Co.
T7 Timken Roller Bearing
T9 Tonawanda Iron Div., Am. Rad. & Stan. San.
T13 Tube Methods Inc.
T19 Techalloy Co. Inc.

U3 Union Wire Rope Corp.
U4 Universal-Cyclops Steel
U5 U. S. Steel Corp.
U6 U. S. Pipe & Foundry
U7 Ulbrich Stainless Steels
U8 U. S. Steel Supply Div., U. S. Steel Corp.
U11 Union Carbide Metals Co.
U13 Union Steel Corp.

V2 Vanadium-Alloys Steel
V3 Vulcan-Kidd Steel Div., H. K. Porter Co.

W1 Wallace Barnes Steel Div., Associated Spring
W2 Wallingford Steel Co.
W3 Washburn Wire Co.
W4 Washington Steel Corp.
W6 Weirton Steel Co.
W8 Western Automatic Machine Screw Co.
W9 Wheatland Tube Co.
W10 Wheeling Steel Corp.
W12 Wickwire Spencer Steel Div., Colo. Fuel & Iron
W13 Wilson Steel & Wire Co.
W14 Wisconsin Steel Div., International Harvester
W15 Woodward Iron Co.
W18 Wyckoff Steel Co.

Y1 Youngstown Sheet&Tube

STRIP

STRIP, Hot-Rolled Carbon

Ala. City, Ala. (27) R2 ...5.10
Allenport, Pa. P7 .....5.10
Alton, Ill. L1 .....5.30
Ashland, Ky. (8) A10 ....5.10
Atlanta A11 .....5.10
Bessemer, Ala. T2 .....5.10
Birmingham C15 .....5.10
Conshohocken, Pa. A3 ..5.15
Detroit M1 .....5.10
Ecorse, Mich. G5 .....5.10
Fairfield, Ala. T2 .....5.10
Farrell, Pa. S3 .....5.10
Fontana, Calif. K1 .....5.825
Gary, Ind. U5 .....5.10
Ind. Harbor, Ind. I-2, Y1 .5.10
Johnstown, Pa. (25) B2 ..5.10
Lackaw'na, N.Y. (25) B2.5.10
LosAngeles (25) B3 .....5.85
LosAngeles C1 .....8.60
Minnequa, Colo. C10 ....6.20
Riverdale, Ill. A1 .....5.10
SanFrancisco S7 .....6.60
Seattle (25) B3 .....6.10
Seattle N14 .....6.60
Sharon, Pa. S3 .....5.10
S. Chicago, Ill. W14 ....5.10
S. SanFrancisco (25) B3 ..5.85
SparrowsPoint, Md. B2 ..5.10
Torrance, Calif. C11 ....5.85
Warren, O. R2 .....5.10
Weirton, W. Va. W6 .....5.10
Youngstown U5 .....5.10

STRIP, Hot-Rolled Alloy

Carnegie, Pa. S18 .....8.40
Farrell, Pa. S3 .....8.40
Gary, Ind. U5 .....8.40
Houston S5 .....8.65
Ind. Harbor, Ind. Y1 ....8.40
KansasCity, Mo. S5 .....8.65
LosAngeles B3 .....9.60
Lowellville, O. S3 .....8.40
Newport, Ky. A2 .....8.40
Sharon, Pa. A2, S3 .....8.40
S. Chicago, Ill. W14 ....8.40
Youngstown U5, Y1 ....8.40

STRIP, Hot-Rolled High-Strength, Low-Alloy

Ashland, Ky. A10 .....7.575
Bessemer, Ala. T2 .....7.575
Conshohocken, Pa. A3 ..7.575
Ecorse, Mich. G5 .....7.575
Fairfield, Ala. T2 .....7.575
Farrell, Pa. S3 .....7.575
Gary, Ind. U5 .....7.575
Ind. Harbor, Ind. I-2, Y1 7.575
Lackawanna, N.Y. B2 ..7.575
LosAngeles (25) B3 ....8.325
Seattle (25) B3 .....8.575
Sharon, Pa. S3 .....7.575
S. Chicago, Ill. W14 ....7.575
S. SanFrancisco (25) B3 8.325
SparrowsPoint, Md. B2 .7.575
Warren, O. R2 .....7.575
Weirton, W. Va. W6 ....7.575
Youngstown U5, Y1 ...7.575

STRIP, Hot-Rolled Ingot Iron

Ashland, Ky. (8) A10 ....5.35
Warren, O. R2 .....5.875

STRIP, Cold-Rolled Carbon

Anderson, Ind. G6 .....7.425
Baltimore T6 .....7.425
Boston T6 .....7.975
Buffalo S40 .....7.425
Cleveland A7, J5 .....7.425
Dearborn, Mich. S3 ....7.425
Detroit D2, M1, P20 ..7.425
Dover, O. G6 .....7.425
Evanston, Ill. M22 .....7.525
Farrell, Pa. S3 .....7.425
Follansbee, W. Va. W10 .7.425
Fontana, Calif. K1 .....9.20
FranklinPark, Ill. T6 ..7.525
Ind. Harbor, Ind. Y1 ...7.425
Indianapolis S41 .....7.575
LosAngeles C1, S41 ....9.30
McKeesport, Pa. E10 ..7.525
NewBedford, Mass. R10 .7.875
NewBritain, Conn. S15 .7.875
NewCastle, Pa. B4, M23 7.425
NewHaven Conn. D2 ..7.875
NewKensington, Pa. A6 7.425
Pawtucket, R.I. R3, N8 7.975
Philadelphia P24 .....7.875
Pittsburgh J5 .....7.425
Riverdale, Ill. A1 .....7.525
Rome, N.Y. (32) R6 ....7.425
Sharon, Pa. S3 .....7.425
Trenton, N.J. (31) R5 ..8.875
Warren, O. R2, T5 .....7.425
Worcester, Mass. A7 ...7.975

STRIP, Cold-Rolled Alloy

Boston T6 .....15.90
Cleveland A7 .....15.55
Carnegie, Pa. S18 .....15.55
Dover, O. G6 .....15.55
Farrell, Pa. S3 .....15.55
FranklinPark, Ill. T6 ..15.55
Harrison, N.J. S18 .....15.55
Indianapolis S41 .....15.70
LosAngeles S41 .....17.75
Lowellville, O. S3 .....15.55
Pawtucket, R.I. N8 ....15.90
Riverdale, Ill. A1 .....15.55
Sharon, Pa. S3 .....15.55
Worcester, Mass. A7 ...15.85
Youngstown S41 .....15.55

STRIP, Cold-Rolled High-Strength, Low-Alloy

Cleveland A7 .....10.80
Dearborn, Mich. S3 ....10.80
Dover, O. G6 .....10.80
Farrell, Pa. S3 .....10.80
Ind. Harbor, Ind. Y1 ....10.80
Sharon, Pa. S3 .....10.80
Warren, O. R2 .....10.80
Weirton, W. Va. W6 ....10.80
Youngstown Y1 .....10.80

STRIP, Cold-Finished Spring Steel (Annealed)	0.26-0.40C	0.41-0.60C	0.61-0.80C	0.81-1.05C	1.06-1.35C
Anderson, Ind. G6	9.10	....	....	....	....
Baltimore T6	9.50	10.70	12.90	15.90	18.85
Boston T6	9.50	10.70	12.90	15.90	18.85
Bristol, Conn. W1	....	10.70	12.90	16.10	19.30
Carnegie, Pa. S18	8.95	10.40	12.60	15.60	....
Cleveland A7	8.95	10.40	12.60	15.60	18.55
Dearborn, Mich. S3	9.05	10.50	12.70	....	....
Detroit D2	9.05	10.50	12.70	15.70	....
Dover, O. G6	8.95	10.40	12.60	15.60	18.55
Evanston, Ill. M22	9.05	10.40	12.60	15.60	....
Farrell, Pa. S3	8.95	10.40	12.60	15.60	18.55
Fostoria, O. S1	10.05	10.40	12.60	15.60	....
FranklinPark, Ill. T6	9.05	10.40	12.60	15.60	18.55
Harrison, N.J. C18	....	....	12.90	16.10	19.30
Indianapolis S41	9.10	10.55	12.60	15.60	18.55
LosAngeles C1	11.15	12.60	14.80	17.80	....
LosAngeles S41	11.15	12.60	14.80	....	....
NewBritain, Conn. S15	9.40	10.70	12.90	15.90	18.85
NewCastle, Pa. B4, M23	8.95	10.40	12.60	15.60	....
NewHaven, Conn. D2	9.40	10.70	12.90	15.90	....
NewKensington, Pa. A6	8.95	10.40	12.60	15.60	....
NewYork W3	....	10.70	12.90	16.10	19.30
Pawtucket, R.I. N8	9.50	10.70	12.90	15.90	18.85
Riverdale, Ill. A1	9.05	10.40	12.60	15.60	18.55
Rome, N.Y. R6	8.95	10.40	12.60	15.60	18.55
Sharon, Pa. S3	8.95	10.40	12.60	15.60	18.55
Trenton, N.J. R5	....	10.70	12.90	15.90	18.85
Warren, O. T5	8.95	10.40	12.60	15.60	18.55
Worcester, Mass. A7, T6	9.50	10.70	12.90	15.90	18.85
Youngstown S41	8.95	10.40	12.60	15.60	18.55

Spring Steel (Tempered)	Up to 0.80C	0.81-1.05C	1.06-1.35C
Bristol, Conn. W1	18.85	22.95	27.80
Buffalo W12	18.85	....	....
Fostoria, O. S1	19.05	22.15	....
FranklinPark, Ill. T6	19.20	23.30	28.15
Harrison, N.J. C18	18.85	22.95	27.80
NewYork W3	18.85	22.95	27.80
Palmer, Mass. W12	18.85	....	....
Trenton, N.J. R5	18.85	22.95	27.80
Worcester, Mass. A7, T6	18.85	22.95	27.80
Youngstown S41	19.20	23.30	28.15

STRIP, Cold-Rolled Ingot Iron

Warren, O. R2 .....8.175

STRIP, C.R., Electrogalvanized

Cleveland A7 .....7.425*
Dover, O. G6 .....7.425*
Evanston, Ill. M22 ....7.525*
McKeesport, Pa. E10 ...7.50*
NewCastle, Pa. M23 ..7.425*
Riverdale, Ill. A1 .....7.525*
Warren, O. B9, S3, T5.7.425*
Worcester, Mass. A7 ...7.975
Youngstown S41, Y1 .7.425*

*Plus galvanizing extras.

STRIP, Galvanized (Continuous)

Farrell, Pa. S3 .....7.50
Sharon, Pa. S3 .....7.50

TIGHT COOPERAGE HOOP

Atlanta A11 .....5.825
Farrell, Pa. S3 .....5.525
Riverdale, Ill. A1 .....5.675
Sharon, Pa. S3 .....5.525
Youngstown U5 .....5.525

TIN MILL PRODUCTS

TIN PLATE, Electrolytic (Base Box)	0.25 lb	0.50 lb	0.75 lb
Aliquippa, Pa. J5	$9.10	$9.35	$9.75
Fairfield, Ala. T2	9.20	9.45	9.85
Fairless, Pa. U5	9.20	9.45	9.85
Fontana, Calif. K1	9.75	10.00	10.40
Gary, Ind. U5	9.10	9.35	9.75
GraniteCity, Ill. G4	9.20	9.45	9.85
IndianaHarbor, Ind. I-2, Y1	9.10	9.35	9.75
Irvin, Pa. U5	9.10	9.35	9.75
Niles, O. R2	9.10	9.35	9.75
Pittsburg, Calif. C11	9.75	10.00	10.40
SparrowsPoint, Md. B2	9.10	9.35	9.75
Weirton, W. Va. W6	9.10	9.35	9.75
Yorkville, O. W10	9.10	9.35	9.75

ELECTROLYTIC TIN-COATED SHEET (Dollars per 100 lb)

Aliquippa, Pa. J5 (21-27 Ga.)	7.90	8.10	....
IndianaHarbor, Ind. Y1 (20-27 Ga.)	7.90	....	....
Niles, O. R2 (20-27 Ga.)	7.90	8.10	8.30

ELECTROLYTIC THIN TIN PLATE (FERROLITE) (¼ lb coating in coils)

	Base Box 45 lb	50 lb	55 lb	60 lb
Fairfield, Ala. T2	$6.20	$6.35	$6.50	$6.65
Fairless, Pa. U5	6.20	6.35	6.50	6.65
Gary, Ind. U5	6.10	6.25	6.40	6.55
Irvin, Pa. U5	6.10	6.25	6.40	6.55

TIN PLATE, Hot Dipped 1.25 lb Common Coke	1.50 lb
Aliquippa, Pa. J5	$10.40 $10.65
Fairfield, Ala. T2	10.50 10.75
Fontana, Calif. K1	11.05 11.30
Gary, Ind. U5	10.40 10.65
Irvin, Pa. U5	10.40 10.65
Pitts., Calif. C11	11.05 11.30
Sp. Pt. Md. B2	10.40 10.65
Weirton, W. Va. W6	10.40 10.65
Yorkville, O. W10	10.40 10.65

BLACK PLATE (Base Box)

Aliquippa, Pa. J5	$8.20
Fairfield, Ala. T2	8.30
Fairless, Pa. U5	8.30
Fontana, Calif. K1	8.85
Gary, Ind. U5	8.20
GraniteCity, Ill. G4	8.30
Ind Harbor, Ind. I-2, Y1	8.20
Irvin Pa. U5	8.20
Niles, O. R2	8.20
Pittsburg, Calif. C11	8.85
SparrowsPoint, Md. B2	8.20
Weirton, W. Va. W6	8.20
Yorkville, O. W10	8.20

HOLLOWARE ENAMELING (Black Plate (29 Gage)

Aliquippa, Pa. J5	7.85
Gary, Ind. U5	7.85
GraniteCity, Ill. G4	7.95
Ind Harbor, Ind. Y1	7.85
Irvin Pa. U5	7.85
Yorkville, O. W10	7.85

SILICON STEEL

C.R. COILS & CUT LENGTHS (22 Ga.)

Fully Processed (Semiprocessed ½c lower)	Field	Armature	Electric	Motor	Dynamo
BeechBottom, W. Va. W10	....	11.70	12.40	13.35	14.65
Brackenridge, Pa. A4	....	....	12.40	13.55	14.65
GraniteCity, Ill. G4	9.975*	11.30*	12.00*	13.15*	....
IndianaHarbor, Ind. I-2	9.875*	11.20*	11.90*	13.05*	....
Mansfield, O. E6	9.875*	11.70	12.40	13.55	14.65
Newport, Ky. A2	9.875	11.70*	12.40*	13.55*	14.65*
Niles, O. M21	9.875*	11.70	12.40	13.55	....
Vandergrift, Pa. U5	9.875*	11.70	12.40	13.55	14.65
Warren, O. R2	9.875*	11.70	12.40	13.55	14.65
Zanesville, O. A10	....	11.70†	12.40	13.55	14.65
					Stator
Vandergrift, Pa. U5					8.10
Mansfield, O. E6					8.10
Warren, O. R2 (Locore)					8.10

SHEETS (22 Ga., coils & cut lengths)

Fully Processed (Semiprocessed ½c lower)	T-72	T-65	T-58	T-52
BeechBottom, W. Va. W10	15.70	16.30	16.80	17.85
Vandergrift, Pa. U5	15.70	16.30	16.80	17.85
Zanesville, O. A10	15.70	16.30	16.80	17.85

C.R. COILS & CUT LENGTHS (22 Ga.)	Grain Oriented T-100	T-90	T-80	T-73	T-66	T-72
Brackenridge, Pa. A4	....	18.10	19.70	20.20	20.70	15.70††
Butler, Pa. A10	....	....	19.70	20.20	20.70	....
Vandergrift, Pa. U5	17.10	18.10	19.70	20.20	20.70	15.70
Warren, O. R2	....	....	....	....	....	15.70‡

*Semiprocessed. †Fully processed only. ‡Coils, annealed; semiprocessed ½c lower. ††Coils only.

WIRE

WIRE, Manufacturers Bright, Low Carbon

AlabamaCity, Ala. R2 ...8.00
Aliquippa, Pa. J5 .....8.00
Alton, Ill. L1 .....8.20
Atlanta A1 .....8.00
Bartonville, Ill. K4 .....8.10
Buffalo W12 .....8.00
Chicago W13 .....8.00
Cleveland A7, C20 .....8.00
Crawfordsville, Ind. M8..8.10
Donora, Pa. A7 .....8.00
Duluth A7 .....8.00
Fairfield, Ala. T2 .....8.00
Fostoria, O. (24) S1 .....8.10
Houston S5 .....8.25
Jacksonville, Fla. M8 ...8.35
Johnstown, Pa. B2 .....8.00
Joliet, Ill. A7 .....8.00
KansasCity, Mo. S5 .....8.25
Kokomo, Ind. C16 .....8.10
LosAngeles B3 .....8.95
Minnequa, Colo. C10 ....8.25
Monessen, Pa. P7, P16...8.00
Palmer, Mass. W12 .....8.30
Pittsburg, Calif. C11 ....8.95
Portsmouth, O. P12 .....8.00
Rankin, Pa. A7 .....8.00
S. Chicago, Ill. R2 .....8.00
S. SanFrancisco C10 .....8.95
SparrowsPoint, Md. B2 ..8.10
Sterling, Ill (1) N15 ....8.00
Sterling, Ill N15 .....8.10
Struthers, O. Y1 .....8.00
Waukegan, Ill. A7 .....8.00
Worcester, Mass. A7 ....8.30

WIRE, Cold Heading Carbon

Elyria, O. W8 .....8.00

WIRE, Gal'd., for ACSR

Bartonville, Ill. K4 .....12.65
Buffalo W12 .....13.40
Cleveland A7 .....12.65
Donora, Pa. A7 .....12.65
Duluth A7 .....12.65
Johnstown, Pa. B2 .....13.40
KansasCity, Mo. U3 ...12.90
Minnequa, Colo. C10 ..12.775
Monessen, Pa. P7, P16..12.65
Muncie, Ind. I-7 .....13.60
NewHaven, Conn. A7 ..12.95
Palmer, Mass. W12 ....13.70
Pittsburg, Calif. C11 ...13.45
Portsmouth, O. P12 ....12.65
Roebling, N.J. R5 .....12.95
SparrowsPt., Md. B2 ....13.50
Struthers, O. Y1 .....13.40
Trenton, N.J. A7 .....12.95
Waukegan, Ill. A7 .....12.65
Worcester, Mass. A7 ....12.95

WIRE, Upholstery Spring

Aliquippa, Pa. J5 .....9.75
Alton, Ill. L1 .....9.95
Buffalo W12 .....9.75
Cleveland A7 .....9.75
Donora, Pa. A7 .....9.75
Duluth A7 .....9.75
Johnstown, Pa. B2 .....9.75
KansasCity, Mo. S5, U3.10.00
Kokomo, Ind. C16 .....9.85
LosAngeles B3 .....10.70
Minnequa, Colo. C10 ....9.95
Monessen, Pa. P7, P16...9.75
NewHaven, Conn. A7 ..10.05
Palmer, Mass. W12 .....10.05
Pittsburg, Calif. C11 ...10.70
Portsmouth, O. P12 .....9.75
Roebling, N.J. R5 .....10.05
S. Chicago, Ill. R2 .....9.75
S. SanFrancisco C10 ....10.70
SparrowsPt., Md. B2 ....9.85
Struthers, O. Y1 .....9.75
Trenton, N.J. A7 .....10.05
Waukegan, Ill. A7 .....9.75
Worcester, Mass. A7, J4..10.05

WIRE, MB Spring, High-Carbon

Aliquippa, Pa. J5 .....9.75
Alton, Ill. L1 .....9.95
Bartonville, Ill. K4 .....9.85
Buffalo W12 .....9.75
Cleveland A7 .....9.75
Donora, Pa. A7 .....9.75
Duluth A7 .....9.75
Fostoria, O. S1 .....9.80
Johnstown, Pa. B2 .....9.75
KansasCity, Mo. S5, U3.10.00
LosAngeles B3 .....10.70
Millbury, Mass. (12) N6 .10.05
Minnequa, Colo. C10 ....9.95
Monessen, Pa. P7, P16..9.75
Muncie, Ind. I-7 .....9.95
Palmer, Mass. W12 .....10.05
Pittsburg, Calif. C11 ...10.70
Portsmouth, O. P12 .....9.75
Roebling, N.J. R5 .....10.05
S. Chicago, Ill. R2 .....9.75
S. SanFrancisco C10 ....10.70
SparrowsPt., Md. B2 ....9.85
Struthers, O. Y1 .....9.75
Trenton, N.J. A7 .....10.05
Waukegan, Ill. A7 .....9.75
Worcester, Mass. A7, J4, T6 10.05

WIRE, Fine & Weaving (8" Coils)

Alton, Ill. L1 .....16.50
Bartonville, Ill. K4 .....16.40
Chicago W13 .....16.30
Cleveland A7 .....16.30
Crawfordsville, Ind. M8..16.40
Fostoria, O. S1 .....16.30
Houston S5 .....16.55
Jacksonville, Fla. M8 ..16.65
Johnstown, Pa. B2 .....16.30
KansasCity, Mo. S5 .....16.55
Kokomo, Ind. C16 .....16.30
Minnequa, Colo. C16 ....16.55
Monessen, Pa. P16 .....16.30
Muncie, Ind. I-7 .....16.50
Palmer, Mass. W12 .....16.60
S. SanFrancisco C10 ....17.15
Waukegan, Ill. A7 .....16.30
Worcester, Mass. A7, J6..16.60

ROPE WIRE (A)

Bartonville, Ill. K4 .....13.45
Buffalo W12 .....13.45
Fostoria, O. S1 .....13.45
Johnstown, Pa. B2 .....13.45
Monessen, Pa. P7 .....13.45
Muncie, Ind. I-7 .....13.65
Palmer, Mass. W12 .....13.75
Portsmouth, O. P12 .....13.45
Roebling, N.J. R5 .....13.75
St. Louis L8 .....13.45
SparrowsPt., Md. B2 ....13.55
Struthers, O. Y1 .....13.45
Worcester, Mass. J4 ....13.75

(A) Plow and Mild Plow; add 0.25c for Improved Plow.

WIRE, Tire Bead

Bartonville,Ill. K4	17.15
Monessen,Pa. P16	17.15
Roebling,N.J. R5	17.65

WIRE, Cold-Rolled Flat

Anderson,Ind. G6	12.35
Baltimore T6	12.65
Boston T6	12.65
Buffalo W12	12.35
Chicago W13	12.45
Cleveland A7	12.35
Crawfordsville,Ind. M8	12.35
Dover,O. G6	12.35
Farrell,Pa. S3	12.35
Fostoria,O. S1	12.35
FranklinPark,Ill. T6	12.45
Kokomo,Ind. C16	12.35
Massillon,O. R8	12.35
Milwaukee C23	12.55
Monessen,Pa. P7, P16	12.35
Palmer,Mass. W12	12.65
Pawtucket,R.I. N8	12.65
Philadelphia P24	12.65
Riverdale,Ill. A1	12.45
Rome,N.Y. R6	12.35
Sharon,Pa. S3	12.35
Trenton,N.J. R5	12.65
Warren,O. B9	12.35
Worcester,Mass. A7, T6	12.65

NAILS, Stock Sizes

	Col.
AlabamaCity,Ala. R2	173
Aliquippa,Pa. J5	173
Atlanta A11	173
Bartonville,Ill. K4	175
Chicago W13	173
Cleveland A9	173
Crawfordsville,Ind. M8	175
Donora,Pa. A7	173
Duluth A7	173
Fairfield,Ala. T2	173
Houston S5	178
Jacksonville,Fla. M8	175
Johnstown,Pa. B2	173
Joliet,Ill. A7	173
KansasCity,Mo. S5	178
Kokomo,Ind. C16	175
Minnequa,Colo. C10	178
Monessen,Pa. P7	173
Pittsburg,Calif. C11	192
Rankin,Pa. A7	173
S.Chicago,Ill. R2	173
Sparrows Pt.,Md. B2	175
Sterling,Ill.(7) N15	175
Worcester,Mass. A7	179

(To Wholesalers: per cwt)

Galveston,Tex. D7	$10.30

NAILS, CUT (100 lb kegs)

Wheeling,W.Va., W10	$10.10

POLISHED STAPLES

	Col.
AlabamaCity,Ala. R2	175
Aliquippa,Pa. J5	173
Atlanta A11	173
Bartonville,Ill. K4	175
Crawfordsville,Ind. M8	177
Donora,Pa. A7	173
Duluth A7	173
Fairfield,Ala. T2	173
Houston S5	180
Jacksonville,Fla. M8	177
Johnstown,Pa. B2	175
Joliet,Ill. A7	173
KansasCity,Mo. S5	180
Kokomo,Ind. C16	177
Minnequa,Colo. C10	178
Pittsburg,Calif. C11	194
Rankin,Pa. A7	173
S.Chicago,Ill. R2	175
SparrowsPt.,Md. B2	177
Sterling,Ill.(7) N15	175
Worcester,Mass. A7	179

TIE WIRE, Automatic Baler (14½ Ga.) (per 97 lb Net Box) Coil No. 3150

AlabamaCity,Ala. R2	$8.78
Atlanta A11	10.36
Bartonville,Ill. K4	8.88
Buffalo W12	10.26
Chicago W13	9.24
Crawfordsville,Ind. M8	8.88
Donora,Pa. A7	8.78
Duluth A7	8.78
Fairfield,Ala. T2	8.78
Houston S5	10.51
Jacksonville,Fla. M8	8.88
Johnstown,Pa. B2	8.78
Joliet,Ill. A7	8.78
KansasCity,Mo. S5	10.51
Kokomo,Ind. C16	8.88
LosAngeles B3	9.44
Minnequa,Colo. C10	9.02
Pittsburg,Calif. C11	9.44
S.Chicago,Ill. R2	8.78
S.SanFrancisco C10	9.94
SparrowsPt.,Md. B2	8.88
Sterling,Ill.(37) N15	8.88

Coil No. 6500 Stand.

AlabamaCity,Ala. R2	$9.06
Atlanta A11	10.70
Bartonville,Ill. K4	9.16
Buffalo W12	10.60
Chicago W13	9.54
Crawfordsville,Ind. M8	9.16
Donora,Pa. A7	9.06
Duluth A7	9.06
Fairfield,Ala. T2	9.06
Houston S5	10.85
Jacksonville,Fla. M8	9.16
Johnstown,Pa. B2	9.06
Joliet,Ill. A7	9.06
KansasCity,Mo. S5	10.85
Kokomo,Ind. C16	9.16
LosAngeles B3	9.75
Minnequa,Colo. C10	9.30
Pittsburg,Calif. C11	9.75
S.Chicago,Ill. R2	9.06
S.SanFrancisco C10	10.26
SparrowsPt.,Md. B2	9.16
Sterling,Ill.(37) N15	9.16

Coil No. 6500 Interim

AlabamaCity,Ala. R2	$9.11
Atlanta A11	10.75
Bartonville,Ill. K4	9.21
Buffalo W12	10.65
Chicago W13	9.59
Crawfordsville,Ind. M8	9.21
Donora,Pa. A7	9.11
Duluth A7	9.11
Fairfield,Ala. T2	9.11
Houston S5	10.90
Jacksonville,Fla. M8	9.21
Johnstown,Pa. B2	9.11
Joliet,Ill. A7	9.11
KansasCity,Mo. S5	10.96
Kokomo,Ind. C16	9.21
LosAngeles B3	9.80
Minnequa,Colo. C10	9.35
Pittsburg,Calif. C11	9.80
S.Chicago,Ill. R2	9.11
S.SanFrancisco C10	10.31
SparrowsPt.,Md. B2	9.21
Sterling,Ill.(37) N15	9.21

BALE TIES, Single Loop

	Col.
AlabamaCity,Ala. R2	212
Atlanta A11	212
Bartonville,Ill. K4	214
Crawfordsville,Ind. M8	214
Donora,Pa. A7	212
Duluth A7	212
Fairfield,Ala. T2	212
Houston S5	217
Jacksonville,Fla. M8	214
Joliet,Ill. A7	212
KansasCity,Mo. S5	217
Kokomo,Ind. C16	214
Minnequa,Colo. C10	217
S.SanFrancisco C10	236
SparrowsPt.,Md. B2	214
Sterling,Ill.(7) N15	214

FENCE POSTS

	Col.
Birmingham C15	177
ChicagoHts.,Ill. C2, I-2	177
Duluth A7	177
Franklin,Pa. F5	177
Johnstown,Pa. B2	177
Marion,O. P11	177
Minnequa,Colo. C10	1-2
Tonawanda,N.Y. B12	177

WIRE, Barbed

	Col.
AlabamaCity,Ala. R2	193**
Aliquippa,Pa. J5	190§
Atlanta A11	197*
Bartonville,Ill. K4	199
Crawfordsville,Ind. M8	198
Donora,Pa. A7	193†
Duluth A7	193†
Fairfield,Ala. T2	193†
Houston S5	198**
Jacksonville,Fla. M8	198
Johnstown,Pa. B2	196§
Joliet,Ill. A7	193†
KansasCity,Mo. S5	198**
Kokomo,Ind. C16	195†
Minnequa,Colo. C10	198**
Monessen,Pa. P7	196§
Pittsburg,Calif. C11	213†
Rankin,Pa. A7	193†
S.Chicago,Ill. R2	193**
S.SanFrancisco C10	213*
SparrowsPoint,Md. B2	198§
Sterling,Ill.(7) N15	198

WOVEN FENCE, 9-15 Ga.

	Col.
Ala.City,Ala. R2	187**
Aliq'ppa,Pa.9-11½ga.J5	190§
Atlanta A11	191*
Bartonville,Ill. K4	193
Crawfordsville,Ind. M8	192
Donora,Pa. A7	187†
Duluth A7	187†
Fairfield,Ala. T2	187†
Houston S5	192**
Jacksonville,Fla. M8	192
Johnstown,Pa.(42) B2	190§
Joliet,Ill. A7	187†
KansasCity,Mo. S5	192**
Kokomo,Ind. C16	189†
Minnequa,Colo. C10	192**
Pittsburg,Calif. C11	210*
Rankin,Pa. A1	187†
S.Chicago,Ill. R2	187**
Sterling,Ill.(7) N15	192

WIRE (16 gage)

	An'ld Stone	Galv. Stone
Ala.City,Ala.R2	17.85	19.40**
Ali'ppa,Pa. J5	17.85	19.65
Bartonville K4	17.95	19.80
Chicago W13	17.85	....
Cleveland A7	17.85	....
Craw'sville M8	17.95	19.80‡‡
Fostoria,O. S1	18.35	19.90†
Houston S5	18.10	19.65**
Jacksonville M8	18.95	19.80‡‡
Johnstown B2	17.85	19.65§
Kan.City,Mo. S5	18.10	....
Kokomo C16	17.95	19.50†
Minnequa C10	18.10	19.65**
P'lm'r,Mass. W12	18.15	19.70†
Pitts.,Calif. C11	18.20	19.75†
S.SanFran. C10	18.20	19.75**
St'ling(37) N15	17.95	19.80
SparrowsPt. B2	17.95	19.75§
Waukegan A7	17.85	19.40†
Worcester A7	18.15	....

WIRE, Merchant Quality (6 to 8 gage)

	An'ld Galv.
Ala.City,Ala. R2	9.00 9.55**
Aliquippa J5	8.65 9.325§
Atlanta(48) A11	9.00 9.75*
Bartonville(48) K4	9.85 19.90
Buffalo W12	9.00 9.55†
Chicago W13	9.00 9.55**
Cleveland A7	9.00 ....
Crawfordsville M8	9.10 9.80††
Donora,Pa. A7	9.00 9.55†
Duluth A7	9.00 9.55†
Fairfield T2	9.00 9.55†
Houston(48) S5	9.25 9.80**
Jack'ville,Fla. M8	9.10 9.80††
Johnstown(48) B2	9.00 9.675§
Joliet,Ill. A7	9.00 9.55†
KansasCity(48)S5	9.25 9.80**
Kokomo(48) S16	9.10 9.65†
LosAngeles B3	9.95 10.025§
Minnequa C10	9.25 9.80**
Monessen(48) P7	8.65 9.35§
Palmer,Mass. W12	9.30 9.85†
Pitts.,Calif. C11	9.95 10.50†
Rankin,Pa. A7	9.00 9.55†
S.Chicago R2	9.00 9.55**
S.SanFran. C10	9.95 10.50**
SparrowsPt.(48)B2	9.10 9.775§
St'ling(37)(48)N15	9.10 9.80
Struthers,O. Y1	9.00 9.85†
Worcester,Mass.A7	9.30 9.85†

Based on zinc prices of: *13.50c. †5c. ‡10c. ‡Less than 10c. ††10.50c. ‡‡11.00c. **Subject to zinc equalization extras.

FASTENERS

(Consumer discounts per cent off list prices, orders for 1 container for assorted sizes; for less than container quantities, add 25 per cent; attaching nuts to bolts, package sizes, add 7.5 per cent; heavy hex nut 1¼ in. through 1¼ in. tapped 8 threads, add 10 per cent)

HEX HEAD CAP SCREWS, coarse, or fine thread, packaged or bulk, with or without hex nuts, 1020 steel bright and high carbon heat treated, ¼ in. thru 1 in. diam., listed lengths:

Plain Finish	50
Hot Galvanized and Zinc Plated:	
Packaged	43.75
Bulk	50

BOLTS Standard stock sizes:

Plain Finish	50
Hot Galvanized and Zinc Plated:	
Packaged	43.75
*Bulk	50

*Hot galvanized or zinc plated lag bolts only — for package or bulk quantities use applicable list less bulk discounts.

HEXAGON NUTS, American Standard: Finished hex, hex jam, and hex slotted coarse or fine thread, ¼ in. through 3 in., finished hex thick, thick and slotted, castle, fine thread, ¼ in. through 1½ in., semi-finished hex heavy, heavy and jam, heavy and slotted, coarse thread, ¼ in. through 4 in., and

SQUARE NUTS, American Standard: Regular square and heavy square, coarse thread, ¼ in. through 2 in.:

Plain Finish	50
Hot Galvanized and Zinc Plated:	
Packages	43.75
Bulk	50

CAP AND SETSCREWS, Fillister Head, Cap Screws, Coarse Thread:

Packages	+5
Bulk	+16

Flat Head Cap Screws:

¾ in. and smaller, 6 in. and shorter:	
Packages	+85
Bulk	+38

Setscrews, Square Head, Cup Point, Coarse Thread:

Through 1 in. diam., 6 in. and shorter:	
Packages	+5
Bulk	19
Through 1 in. diam., longer than 6 in.:	
Packages	+29

RIVETS

F.o.b. Cleveland and/or freight equalized with Pittsburgh, f.o.b. Chicago and/or freight equalized with Birmingham except where equalization is too great.

Structural ½ in., larger 12.85
⅞ in. and smaller by 6 in. and shorter: 15% off list.

PRESTRESSED STRAND

(High strength, stress relieved; 7 wire uncoated. Net prices per 1000 ft, 40,000 lb and over)

	Standard Diameter, Inches				
	1/4	5/16	3/8	7/16	1/2
Buffalo W12	$26.20	$38.50	$47.90	$61.30	$86.30
KansasCity,Mo. U3	26.20	38.50	47.90	61.30	80.30
Minnequa,Colo. C10	26.20	38.50	47.90	61.30	80.30
Pittsburg,Calif. C11	26.20	38.50	47.90	61.30	80.30
Roebling,N.J. R5	26.20	38.50	47.90	61.30	80.30
SparrowsPoint,Md. B2	26.20	38.50	47.90	61.30	80.30
St. Louis L8	26.20	38.50	47.90	61.30	80.30
Waukegan,Ill. A7	26.20	38.50	47.90	61.30	80.30

BOILER TUBES

Net base c.l. prices, dollars per 100 ft, mill; minimum wall thickness, cut length 10 to 24 ft, inclusive.

O.D. In.	B.W. Gage	Seamless H.R.	Seamless C.D.	Elec. Weld H.R.
1	13	....	27.24	23.13
1¼	13	....	32.25	24.41
1½	13	30.42	35.65	26.98
1¾	13	35.94	42.12	31.89
2	13	40.28	47.21	35.74
2¼	13	45.36	53.17	40.26
2½	12	49.24	57.72	43.70
2½	12	54.23	63.57	48.13
2¾	12	58.73	68.83	52.13
3	12	62.62	73.40	55.59

RAILWAY MATERIALS

Rails	Standard No. 1	Standard No. 2	All No. 2	Tee Rails 60 lb Under
Bessemer,Pa. U5	5.75	5.65	....	6.725
Ensley,Ala. T2	5.75	5.65	....	6.725
Fairfield,Ala. T2	....	....	....	6.725
Gary,Ind. U5	5.75	5.65	....	....
Huntington,W.Va. C15	....	....	....	6.725
Johnstown,Pa. B2	....	....	....(16)	6.725
Lackawanna,N.Y. B2	5.75	5.65	....	6.725
Minnequa,Colo. C10	5.75	5.65	....	7.225
Steelton,Pa. B2	5.75	5.65	....	....
William sport,Pa. S19	....	....	....	6.725

TIE PLATES

Fairfield,Ala. T2	6.875
Gary,Ind. U5	6.875
Lackawanna,N.Y. B2	6.875
Minnequa,Colo. C10	6.875
Seattle B3	7.025
Steelton,Pa. B2	6.875
Torrance,Calif. C11	7.025

JOINTS BARS

Bessemer,Pa. U5	7.25
Fairfield,Ala. T2	7.25
Joliet,Ill. U5	7.25
Lackawanna,N.Y. B2	7.25
Minnequa,Colo. C10	7.25
Steelton,Pa. B2	7.25

AXLES

Ind.Harbor,Ind. S13	9.125
Johnstown,Pa. B2	9.125

SCREW SPIKES

Lebanon,Pa. B2	15.10

TRACK BOLTS, Untreated

Cleveland R2	15.35
KansasCity,Mo. S5	15.35
Lebanon,Pa. B2	15.35
Minnequa,Colo. C10	15.35
Pittsburgh S44	15.35
Seattle B3	15.85

STANDARD TRACK SPIKES

Fairfield,Ala. T2	10.10
Ind.Harbor,Ind. I-2, Y1	10.10
KansasCity,Mo. S5	10.10
Lebanon,Pa. B2	10.10
Minnequa,Colo. C10	10.10
Pittsburgh J5	10.10
Seattle B3	10.60
S.Chicago,Ill. R2	10.10
Struthers,O. Y1	10.10
Youngstown R2	10.10

Footnotes

(1) Chicago base.
(3) Merchant.
(4) Reinforcing.
(5) 1¼ to under 1 7/16 in.; 1 7/16 to under 1 15/16 in.; 6.70c; 1 15/16 to 8 in., inclusive, 7.05c
(6) Limited analyses only.
(7) Chicago base 2 cuts lower.
(8) 16 Ga. and heavier.
(9) Merchant quality; add 0.35c for special quality.
(12) Worcester, Mass., base.
(15) ⅝" and thinner.
(16) 40 lb and under.
(17) Flats only; 0.25 in. & heavier.
(23) Special quality.
(24) Deduct 0.05c, finer than 15 Ga.
(25) Bar mill bands.
(26) Deld. in mill zone, 5.65c.
(27) Bar mill sizes.
(28) Bonderized.
(30) Sheared; for universal mill add 0.45c.
(31) Widths over ⅝ in.; 7.375c, for widths ⅝ in. and under by 0.125 in. and thinner.
(32) Buffalo base.
(33) 14 Ga., 48 in.
(35) 72" and narrower.
(36) 54" and narrower.
(37) Chicago base, 10 points lower.
(38) 13 Ga. & lighter; 60" & narrower.
(39) 48" and narrower.
(43) 9-14½ Ga.
(44) To fabricators.
(48) 6-7 Ga.
(49) 3½ in. and smaller rounds and 2½ in. and smaller hexagons; 9.65c for larger rounds and hexagons and other shapes.

SEAMLESS STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Size—Inches	2		2½		3		3½		4		5		6	
List Per Ft	37c		58.5c		76.5c		92c		$1.09		$1.48		$1.92	
Pounds Per Ft	3.68		5.82		7.62		9.20		10.89		14.81		19.18	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25
Ambridge, Pa. N2	+12.25	....	+5.75	....	+3.25	....	+1.75	....	+1.75	....	+2	....	0.5	....
Lorain, O. N3	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25
Youngstown Y1	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25

ELECTRICWELD STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Youngstown R2	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25

BUTTWELD STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Size—Inches	⅛		¼		⅜		½		¾		1		1¼	
List Per Ft	5.5c		6c		6c		8.5c		11.5c		17c		23c	
Pounds Per Ft	0.24		0.42		0.57		0.85		1.13		1.68		2.28	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Alton, Ill. L1	....	....	....	....	....	....	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Benwood, W. Va. W10	1.5	+27	+10.5	+36	+21	+45.5	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Butler, Pa. F6	4.5	+24	+8.5	+34	+19.5	+44	....	....	....	....	....	....	....	....
Etna, Pa. N2	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Fairless, Pa. N3	....	....	....	....	....	....	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Fontana, Calif. K1	....	....	....	....	....	....	+10.75	+28	+7.75	+24	+4.25	+19.5	+1.75	+18.25
Indiana Harbor, Ind. Y1	....	....	....	....	....	....	1.25	+16	4.25	+12	7.75	+7.5	10.25	+6.25
Lorain, O. N3	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Sharon, Pa S4	4.5	+24	+8.5	+34	+19.5	+44	....	....	....	....	....	....	....	....
Sharon, Pa. M6	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Sparrows Pt., Md. B2	2.5	+26	+10.5	+36	+21.5	+46	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Wheatland, Pa. W9	4.5	+24	+8.5	+34	+19.5	+44	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Youngstown R2, Y1	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25

Size—Inches	1½		2		2½		3		3½		4	
List Per Ft	27.5c		37c		58.5c		76.5c		92c		$1.09	
Pounds Per Ft	2.75		3.68		5.82		7.62		9.20		10.89	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Alton, Ill. L1	9.75	+6.25	10.25	+5.75	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Benwood, W. Va. W10	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Etna, Pa. N2	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Fairless, Pa. N3	9.75	+6.25	10.25	+5.75	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Fontana, Calif. K1	+1.25	+17.25	+0.75	+16.75	0.75	+16.5	0.75	+16.5	+9.75	+27.5	+9.75	+27.5
Indiana Harbor, Ind. Y1	10.75	+5.25	11.25	+4.75	12.75	+4.5	12.75	+4.5	2.25	+15.5	2.25	+15.5
Lorain, O. N3	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	....	....	....	....
Sharon, Pa. M6	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	....	....	....	....
Sparrows Pt., Md. B2	9.75	+6.25	10.25	+5.75	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Wheatland, Pa. W9	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Youngstown R2, Y1	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5

*Galvanized pipe discounts based on price of zinc at 13.00c, East St. Louis.

Stainless Steel

Representative prices, cents per pound; subject to current lists of extras

AISI Type	—Rerolling— Ingot	Slabs	Forging Billets	H.R. Strip	H.R. Rods; C.F. Wire	H.R. Bars; Structural Shapes	Plates	Sheets	C.R. Strip; Flat Wire
201	22.75	25.00	....	36.00	....	43.50	39.25	48.50	45.00
202	24.75	28.25	37.75	39.00	42.25	44.50	40.00	49.25	49.25
301	24.00	26.00	38.75	37.25	43.50	46.00	41.25	51.25	47.50
302	26.25	29.50	39.50	40.50	44.25	46.75	42.25	52.00	52.00
302B	26.50	30.75	42.25	45.75	46.75	49.00	44.50	57.00	57.00
303	....	33.25	42.50	....	47.25	49.75	45.00	56.75	56.75
304	28.00	29.50	39.50	40.50	44.25	46.75	45.75	52.00	52.00
304L	....	37.25	47.25	48.25	52.00	51.50	53.50	59.75	59.75
305	29.50	34.75	44.00	47.50	47.00	49.50	46.25	58.75	58.75
308	32.00	36.25	49.00	50.25	54.75	57.75	55.25	63.00	63.00
309	41.25	47.50	60.00	64.50	66.25	69.50	66.00	80.50	80.50
310	51.50	59.50	81.00	84.25	89.75	94.50	87.75	96.75	96.75
314	....	....	80.50	....	89.75	94.50	87.75	....	104.25
316	41.25	47.50	64.50	68.50	71.75	75.75	71.75	80.75	80.75
316L	....	55.25	72.25	76.25	79.50	83.50	79.50	88.50	88.50
317	49.75	58.00	79.75	88.25	89.50	94.25	88.50	101.00	101.00
321	33.50	38.00	48.75	53.50	54.50	57.50	54.75	65.50	65.50
330	....	....	123.25	....	95.75	143.75	135.00	149.25	149.25
18-8 CbTa	38.50	48.25	57.75	63.50	63.75	67.25	61.75	79.25	79.25
403	....	....	29.25	....	33.25	35.00	30.00	40.25	40.25
405	20.25	26.50	30.75	36.00	34.75	36.50	32.50	46.75	46.75
410	17.50	19.50	29.25	31.00	33.25	35.00	30.00	40.25	40.25
416	....	....	29.75	....	33.75	35.50	31.25	48.25	48.25
420	....	31.50	35.50	41.75	40.75	42.75	40.25	62.00	62.00
430	17.75	19.75	29.75	32.00	33.75	35.50	31.00	40.75	40.75
430F	....	....	30.50	....	34.25	36.00	31.75	51.75	51.75
431	....	29.75	39.25	....	43.50	46.00	41.00	56.00	56.00
446	....	....	40.75	59.00	46.00	48.25	42.75	70.00	70.00

Producers Are: Allegheny Ludlum Steel Corp.; American Steel & Wire Div., U. S. Steel Corp.; Anchor Drawn Steel Co., division of Vanadium-Alloys Steel Co.; Armco Steel Corp.; Babcock & Wilcox Co.; Bethlehem Steel Co.; J. Bishop & Co.; A. M. Byers Co.; Calstrip Steel Corp.; G. O. Carlson Inc.; Carpenter Steel Co.; Carpenter Steel Co. of New England; Charter Wire Products; Crucible Steel Co. of America; Damascus Tube Co.; Dearborn Div., Sharon Steel Corp.; Wilbur B. Driver Co.; Driver-Harris Co.; Eastern Stainless Steel Corp.; Firth Sterling Inc.; Fort Wayne Metals Inc.; Green River Steel Corp., subsidiary of Jessop Steel Co.; Indiana Steel & Wire Co.; Ingersoll Steel Div., Borg-Warner Corp.; Ellwood Ivins Steel Tube Works Inc.; Jessop Steel Co.; Johnson Steel & Wire Co. Inc.; Stainless & Strip Div., Jones & Laughlin Steel Corp.; Joslyn Stainless Steels, division of Joslyn Mfg. & Supply Co.; Latrobe Steel Co.; Lukens Steel Co.; Maryland Fine & Specialty Wire Co. Inc.; McLouth Steel Corp.; Metal Forming Corp.; Midvale-Heppenstall Co.; National Standard Co.; National Tube Div., U. S. Steel Corp.; Pacific Tube Co.; Page Steel & Wire Div., American Chain & Cable Co. Inc.; Pittsburgh Rolling Mills Inc.; Republic Steel Corp.; Riverside-Alloy Metal Div., H. K. Porter Company Inc.; Rodney Metals Inc.; Sawhill Tubular Products Inc.; Sharon Steel Corp.; Simonds Saw & Steel Co.; Somers Brass Co.; Specialty Wire Co. Inc.; Standard Tube Co.; Superior Steel Div., Copperweld Steel Co.; Superior Tube Co.; Swepco Tube Corp.; Techalloy Co. Inc.; Timken Roller Bearing Co.; Trent Tube Co., subsidiary of Crucible Steel Co. of America; Tube Methods Inc.; Ulbrich Stainless Steel Inc.; Union Steel Corp.; U. S. Steel Corp.; Universal Cyclops Steel Corp.; Vanadium-Alloys Steel Co.; Wall Tube & Metal Products Co.; Wallingford Steel, subsidiary of Allegheny Ludlum Steel Corp.; Washington Steel Corp.; Seymour Mfg. Co.

Clad Steel

	Plates 5%	Plates Carbon Base 10%	Plates Carbon Base 15%	Plates Carbon Base 20%	Sheets Carbon Base 20%
Stainless					
302	....	....	....	....	37.50
304	26.05	28.80	31.55	34.30	39.75
304L	30.50	33.75	36.95	40.15	....
316	38.20	42.20	46.25	50.25	58.25
316L	42.30	46.75	51.20	55.65	....
316 Cb	49.90	55.15	60.40	65.65	....
321	31.20	34.50	37.75	41.05	47.25
347	36.90	40.80	44.65	48.55	57.00
405	22.25	24.60	26.90	29.25	....
410	20.55	22.70	24.85	27.00	....
430	21.20	23.45	25.65	27.90	....
Inconel	49.80	61.35	72.80	84.40	....
Nickel	43.20	55.05	66.95	78.90	....
Nickel, Low Carbon	43.50	55.70	67.95	80.35	....
Monel	44.25	55.35	66.45	77.60	....

	Strip, Carbon Base —Cold Rolled— 10%	Both Sides
Copper*	36.80	44.29

*Deoxidized. Production points: Stainless-clad sheets, New Castle, Ind. I-4; stainless-clad plates, Claymont, Del. C22; Coatesville, Pa. L7; New Castle, Ind. I-4, and Washington, Pa. J3; nickel, inconel, monel-clad plates, Coatesville L7; copper-clad strip, Carnegie, Pa. S18.

Tool Steel

Grade	$ per lb	Grade	$ per lb
Reg. Carbon (W-1)	0.330	Hi-Carbon-Cr (D-11)	0.955
Spec. Carbon (W-1)	0.345	V-Cr Hot Work (H-13)	0.550
Oil Hardening (O-1)	0.505	W-Cr Hot Work (H-12)	0.530
V-Cr Hot Work (H-11)	0.505	W Hot Wk (H-21)	1.425-1.44

Grade by Analysis (%) W	Cr	V	Co	Mo	AISI Designation	$ per lb
18	4	1	....	....	T-1	1.840
18	4	2	....	....	T-2	2.005
13.5	4	3	....	....	T-3	2.105
18.25	4.25	1	4.75	....	T-4	2.545
18	4	2	9	....	T-5	2.915
20.25	4.25	1.6	12.95	....	T-6	4.330
13.75	3.75	2	5	....	T-8	2.485
1.5	4	1	....	8.5	M-1	1.200
6.4	4.5	1.9	....	5	M-2	1.345
6	4	3	....	6	M-3	1.590

Tool steel producers include: A4, A8, B2, B8, C4, C9, C12, C18, F2, J3, L3, M14, S8, U4, V2, and V3.

Pig Iron

Prices in dollars per gross ton, f.o.b. (rail) furnace; add 50 cents when shipped by truck. Maximum delivered prices are approximate and based on rail shipment.

	Basic	No. 2 Foundry	Malleable	Bessemer
Birmingham District				
Birmingham R2	62.00	62.50**	66.50	....
Birmingham U6	....	62.50**	66.50	....
Woodward, Ala. W15	62.00*	62.50**	66.50	....
Cincinnati, deld.	....	70.20	....	....
Buffalo District				
Buffalo H1, R2	66.00	66.50	67.00	67.50
N. Tonawanda, N.Y. T9	....	66.50	67.00	67.50
Tonawanda, N.Y. W12	66.00	66.50	67.00	67.50
Boston, deld.	77.29	77.79	78.29	....
Rochester, N.Y., deld.	69.02	69.52	70.02	....
Syracuse, N.Y., deld.	70.12	70.62	71.12	....
Chicago District				
Chicago I-3	66.00	66.50	66.50	67.00
S. Chicago R2	66.00	66.50	66.50	67.00
S. Chicago, Ill. W14	66.00	....	66.50	67.00
Milwaukee deld.	69.02	69.52	69.52	70.02
Muskegon, Mich., deld.	....	74.52	74.52	....
Cleveland District				
Cleveland R2, A7	66.00	66.50	66.50	67.00
Akron, Ohio, deld.	69.52	70.02	70.02	70.52
Mid-Atlantic District				
Birdsboro, Pa. B10	68.00	68.50	69.00	69.50
Chester, Pa. P4	Nom.	Nom.	Nom.	....
Swedeland, Pa. A3	68.00	68.50	69.00	69.50
New York, deld.	....	75.50	76.00	....
Newark, N.J., deld.	72.69	73.19	73.69	74.19
Philadelphia, deld.	70.41	70.91	71.41	71.99
Troy, N.Y. R2	68.00	68.50	69.00	69.50
Boston, deld.	75.20	75.70	76.20	76.70
Pittsburgh District				
Neville Island, Pa. P8	66.00	66.50	66.50	67.00
Pittsburgh (N&S sides), Aliquippa, deld.	....	67.95	67.95	68.48
McKees Rocks, Pa., deld.	....	67.60	67.60	68.13
Lawrenceville, Homestead, Wilmerding, Monaca, Pa., deld.	....	68.26	68.26	69.79
Verona, Trafford, Pa., deld.	68.29	68.82	68.82	69.35
Brackenridge, Pa. deld.	68.60	69.10	69.10	69.63
Midland, Pa. C18	66.00	....	....	....
Youngstown District				
Hubbard, Ohio Y1	....	....	66.50	....
Sharpsville, Pa. S6	66.00	....	66.50	67.00
Youngstown Y1	....	....	66.50	....
Mansfield, Ohio, deld.	71.30	....	71.80	72.30
Duluth I-3	66.00	66.50	66.50	67.00
Erie, Pa. I-3	66.00	66.50	66.50	67.00
Fontana, Calif. K1	75.00	75.50	....	....
Geneva, Utah C11	66.00	66.50	....	....
Granite City, Ill. G4	67.90	68.40	68.90	....
Ironton, Utah C11	66.00	66.50	....	....
Minnequa, Colo. C10	68.00	68.50	69.00	....
Rockwood, Tenn. T3	62.00	62.50‡	66.50	67.00
Toledo, Ohio I-3	66.00	66.50	66.50	67.00
Cincinnati, deld.	72.94	73.44	....	....

*Phos. 0.70-0.90%; Phos. 0.30-0.69%, $63.
**Phos. 0.70-0.90%; Phos. 0.30-0.69%, $63.50.
‡Phos. 0.50% up; Phos. 0.30-0.49%, $63.50.

PIG IRON DIFFERENTIALS

Silicon: Add 75 cents per ton for each 0.25% Si or percentage thereof over base grade, 1.75-2.25%, except on low phos. iron on which base is 1.75-2.00%.

Manganese: Add 50 cents per ton for each 0.25% manganese over 1% or portion thereof.

BLAST FURNACE SILVERY PIG IRON, Gross Ton

(Base 6.01-6.50% silicon; add 75c for each 0.50% silicon or portion thereof over the base grade within a range of 6.50 to 11.50%; starting with silicon over 11.50% add $1.50 per ton for each 0.50% silicon or portion thereof up to 14%; add $1 for each 0.50% Mn over 1%)

Jackson, Ohio I-3, J1	$78.00
Buffalo H1	79.25

ELECTRIC FURNACE SILVERY IRON, Gross Ton

(Base 14.01-14.50% silicon, add $1 for each 0.5% Si to 18%; $1.25 for each 0.50% Mn over 1%; $2 per gross ton premium for 0.045% max P)

Calvert City, Ky. P15	$99.00
Niagara Falls, N.Y. P15	99.00
Keokuk, Iowa Open-hearth & Fdry. K2	89.00
Keokuk, Iowa O.H. & Fdry, 12½ lb piglets, 16% Si, K2	92.00

LOW PHOSPHORUS PIG IRON, Gross Ton

Birdsboro, Pa. B10 (Phos. 0.075% max)	$73.00
Lyles, Tenn. T3 (Phos. 0.035% max)	73.00
Rockwood, Tenn. T3 (Phos. 0.035% max)	73.00
Buffalo H1 (Intermediate) (0.036-0.075% max)	71.50
Cleveland A7 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Duluth I-3 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Erie, Pa. I-3 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Neville Island, Pa. P6 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Swedeland, Pa. A3 (Intermediate) (Phos. 0.036-0.075% max)	73.00
Troy, N.Y. R2 (Phos. 0.075% max)	73.00

Steel Service Center Products

Representative prices, cents per pound, f.o.b. warehouse, for 2000 lb items (except stainless) ordered by themselves. Prices will vary with total weight of the order or weight of the individual items or both. Base quantities for stainless sheets: 8000 lb, except in Chicago, New York, Boston, Los Angeles, and San Francisco, 10,000 lb. City delivery charges are 15 cents per 100 lb except: Denver, 20 cents; Baltimore, Boston, New York, Philadelphia, San Francisco, 10 cents; Atlanta, Birmingham, Dallas, Houston, Los Angeles, Seattle, no charge.

	SHEETS				STRIP	BARS			STRUCTURAL	PLATES	
	Hot Rolled	Cold Rolled	Galv.	Stainless Type 302	Hot Rolled	H.R. Rounds	C.F. Rounds	H.R. Alloy 4140	SHAPES	Carbon	Floor
Atlanta	9.37	10.61	11.83	....	10.85	9.53	13.24	....	9.94	9.73	11.16
Baltimore	8.27	8.66	10.06	....	8.28	8.95	11.80	16.38	9.53	8.84	10.43
Birmingham	9.43	10.20	10.46	....	10.41	8.26	13.14	16.76	8.47	8.41	10.06
Boston	9.67	10.58	11.77	53.50	12.16	9.77	13.35	16.59	10.16	9.62	11.08
Buffalo	8.65	9.80	11.25	55.98	11.00	8.75	11.45	16.30	9.15	8.65	11.10
Charlotte, N. C.	9.87	11.22	10.30	....	10.86	9.67	12.68	....	9.88	9.82	11.46
Chicago	8.57	10.20	10.15	52.00	10.74	8.55	10.65	15.95	8.91	8.41	10.68
Cincinnati	8.74	10.26	10.20	65.30	11.06	8.87	11.53	16.27	9.47	8.79	11.01
Cleveland	8.57	9.98	11.24	58.18	10.86	8.66	11.25	16.06	9.30	8.65	10.92
Dallas	9.62	10.43	12.59	....	11.18	9.03	12.98	16.95	9.26	9.35	11.00
Detroit	8.83	10.46	10.50	52.00	11.11	8.86	11.01	16.23	9.47	8.78	10.94
Denver	9.41	11.77	12.11	....	9.86	10.10	11.47	....	10.02	9.69	11.83
Houston	9.22	10.03	12.19	52.00	10.78	8.63	13.10	16.55	8.86	8.95	10.60
Indianapolis	9.01	10.64	10.59	....	11.18	8.99	11.09	16.39	9.35	8.85	11.12
Kansas City	9.21	10.87	11.35	....	10.87	9.31	11.57	15.72	9.80	9.10	....
Los Angeles	8.95	11.29	11.35	61.27	10.65	9.00	14.20	17.35	9.90	8.40	11.15
Memphis, Tenn.	9.84	10.05	....	....	11.24	9.92	12.74	....	10.33	10.12	11.41
Milwaukee	8.71	10.34	10.29	....	10.88	8.69	10.89	16.09	9.13	8.55	10.82
Moline, Ill.	9.24	10.70	11.45	....	10.90	9.34	11.15	16.45	9.83	9.17	10.96
Newark, N. J.	9.36	10.13	11.35	....	11.46	9.74	13.25	16.40	10.20	9.51	11.05
New York	9.36	10.13	11.35	52.98	11.46	9.74	13.25	16.40	10.20	9.51	11.05
Philadelphia	8.85	10.00	10.89	52.71	10.35	8.75	11.95	16.38	8.95	8.70	9.95
Pittsburgh	8.57	9.98	11.13	52.00	10.84	8.55	11.25	15.95	8.91	8.41	10.68
Portland, Oreg.	10.20	12.05	12.35	....	12.20	10.20	16.65	17.80	10.80	10.35	12.50
St. Louis	8.77	10.58	10.53	....	10.94	8.77	11.28	16.33	9.14	8.62	10.91
St. Paul	8.84	9.59	10.84	....	11.01	8.82	11.49	16.54	9.18	8.68	10.44
San Francisco	10.17	11.69	11.40	54.00	11.78	10.07	15.10	17.25	10.49	10.38	12.47
Seattle	10.51	11.57	12.50	54.02	11.95	9.94	16.20	17.80	10.65	10.10	12.73
Spokane, Wash.	10.36	11.42	12.35	54.02	11.80	9.79	16.20	17.80	10.50	9.95	12.58

Specifications: Hot rolled sheet, sheared edge, 10 Ga. & 36 x 96-120 in.; cold rolled sheets, 20 Ga. & 36 x 96-120 in.; galvanized sheets, 10 Ga. x 36 x 120 in. except Dallas and Houston, 10 Ga. x 48 x 120 in.; stainless, 16 Ga. x 36 in.; hot rolled strip, ⅛ in. x 1 in.; hot rolled carbon bars, rounds, ⅜ in.—1¼ in., M1020; cold finished bars, 1 in., C1018; hot rolled alloy bars, 4140 annealed, 1⅝ in.—2⅞ in. rounds; structural shapes, I beams, 6 x 12½ in.; carbon plates, sheared, through ½ in. x 84 in.; floor plates, ¼ in. x 36 in.

Refractories

Fire Clay Brick (per 1000 pieces*)

High-Heat Duty: Ashland, Grahn, Hayward, Hitchins, Haldeman, Olive Hill, Ky., Athens, Troup, Tex., Beech Creek, Clearfield, Curwensville, Lock Haven, Lumber, Orviston, West Decatur, Winburne, Snow Shoe, Pa., Bessemer, Ala., Farber, Mexico, St. Louis, Vandalia, Mo., Ironton, Oak Hill, Parrall, Portsmouth, Ohio, Ottawa, Ill., Stevens Pottery, Ga., Canon City, Colo., $140; Salina, Pa., $145; Niles, Ohio, $146; Cutler, Utah, $175.

Super-Duty: Ironton, Ohio, Vandalia, Mo., Olive Hill, Ky., Clearfield, Salina, Winburne, Snow Shoe, Pa., New Savage Md., St. Louis, $185; Stevens Pottery, Ga., $195; Cutler, Utah, $248.

Silica Brick (per 1000 pieces*)

Standard: Alexandria, Claysburg, Mt. Union, Sproul, Pa., Ensley, Ala., Pt. Matilda, Pa., Portsmouth, Ohio, Hawstone, Pa., St. Louis, $158; Warren, Niles, Windham, Ohio, Hays, Latrobe, Morrisville, Pa., $163; E. Chicago, Ind., Joliet, Rockdale, Ill., $168; Canon City, Colo., $173; Lehi, Utah, $183; Los Angeles, $185.

Super-Duty: Sproul, Hawstone, Pa., Niles, Warren, Windham, Ohio, Leslie, Md., Athens, Tex., $155; Morrisville, Hays, Latrobe, Pa., $163; E. Chicago, Ind., St. Louis, $165; Canon City, Colo., $183; Curtner, Calif., $185.

Semisilica Brick (per 1000 pieces*)

Woodbridge, N. J., Canon City, Colo., $140; Philadelphia, Clearfield, Pa., $145.

Ladle Brick (per 1000 pieces*)

Dry-Pressed: Alsey, Ill., Chester, New Cumberland, W. Va., Freeport, Johnstown, Merrill Station, Pa., Mexico, Vandalia, Mo., New Salisbury, Ohio, $97; Vanport Pa., Wellsville, Irondale, Ohio, $100; Clearfield, Pa., Portsmouth, Ohio, $102; St. Louis, $120.

High-Alumina Brick (per 1000 pieces*)

50 *Per Cent:* St. Louis, Mexico, Vandalia, Mo., Danville, Ill., $250; Philadelphia, $265; Clearfield, Pa., $230; Orviston, Snow Shoe, Pa., $260.

60 *Per Cent:* St. Louis, Mexico, Vandalia, Mo., $310; Danville, Ill., $312; Clearfield, Orviston, Snow Shoe, Pa., $320; Philadelphia, $325.

70 *Per Cent:* St. Louis, Mexico, Vandalia, Mo., $350; Danville, Ill. $353, Clearfield, Orviston, Snow Shoe, Pa., $360; Philadelphia, $365.

Sleeves (per 1000)

St. Louis, $193; Reesdale, Johnstown, Bridgeburg, St. Charles, Pa., $188; Ottawa, Ill., $205.

Nozzles (per 1000)

Reesdale, Johnstown, Bridgeburg, St. Charles, Pa., St. Louis, $310.

Runners (per 1000)

Reesdale, Johnstown, Bridgeburg, St. Charles, Clearfield, Pa., $234.

Dolomite (per net ton)

Domestic, dead-burned bulk, Billmeyer, Blue Bell, Williams, Plymouth Meeting, York, Pa., Millville, W. Va., Bettsville, Millersville, Martin, Woodville, Gibsonburg, Narlo, Ohio, $16.75; Thornton, McCook, Ill., $17; Dolly Siding, Bonne Terre, Mo., $15.00.

Magnesite (per net ton)

Domestic, dead-burned, ½ in. grains with fines: Chewelah, Wash., Luning, Nev. $46; ⅜ in. grains with fines; Baltimore (periclase), $73; Pascagoula, Miss. (periclase), $90.

*—9 in. x 4½ x 2.50 straights.

Fluorspar

Metallurgical grades, f.o.b. shipping point in Ill., Ky., net tons, carloads, effective CaF_2 content 72.5%, $37-$41; 70%, $36-$40; 60%, $33-$36.50. Imported, net ton, f.o.b. cars point of entry, duty paid, metallurgical grade; European, $30-$33, contract; Mexican, all rail, duty paid, $28-$28.50; barge, Brownsville, Tex., $30-$31.

Ores

Lake Superior Iron Ore

(Prices effective for the 1960 shipping season, subject to later revision, gross ton, 51.50% iron natural, rail of vessel, lower lake ports.)

Mesabi bessemer	$11.60
Lump, ½ in. and up	12.85
Fines, under ½ in.	10.72
Mesabi nonbessemer	11.45
Old Range bessemer	11.85
Old Range nonbessemer	11.70
Open-hearth lump	12.70
High phos.	11.45

The foregoing prices are based on upper lake rail freight rates, lake vessel freight rates, handling and unloading charges, and taxes thereon, which were in effect Jan. 1, 1960, and increases or decreases after that date are absorbed by the seller.

Eastern Local Iron Ore

Cents per unit, deld. E. Pa.

New Jersey, concentrates	nom.

Foreign Iron Ore

Cents per unit

Swedish basic, 65%, c.i.f. Atlantic ports	23.00†
Chilean, 62-65%, c.i.f. Atlantic ports	22.00
Brazilian, 68.5%, f.o.b. vessel, Victoria, per ton	$11.50

Tungsten Ore

Net ton, unit

Foreign wolframite, good commercial quality	$19.75-20.00
Domestic, concentrates, f.o.b. milling points	22.00-23.00

*Before duty. †Nominal.

Manganese Ore

Mn 46-58%, Indian, 85-90c, nom. per long ton unit, c.i.f. U. S. ports, duty for buyer's account.

Chrome Ore

Gross ton, f.o.b. cars New York, Philadelphia, Baltimore, Charleston, S. C., plus ocean freight differential for delivery to Portland, Oreg., Tacoma, Wash.

Indian and Rhodesian

48% 3:1	$34.00-35.00†
48% no ratio	25.00-26.00†

South African Transvaal

44% no ratio	18.75†
48% no ratio	24.00-26.00†

Turkish

48% 3:1	36.00-37.00†

Domestic

Rail nearest seller

18% 3:1	30.00

Molybdenum

Sulfide concentrate, per lb of Mo content, mines, unpacked	$1.23

Antimony Ore

Per short ton unit of Sb content, c.i.f. seaboard

55-60%	$2.50-2.80
60-65%	2.80-3.20

Vanadium Ore

Cents per lb V_2O_5

Domestic	31.00

†Nominal.

Electrodes

Threaded with nipple; unboxed, f.o.b. plant

GRAPHITE

Diam (Inches)	Length (Inches)	Per 100 lb
2	24	$64.00
2½	30	41.50
3	40	39.25
4	40	37.00
5½	40	36.50
6	60	33.25
7	60	29.75
8, 9, 10	60	29.50
12	72	28.25
14	60	28.25
16	72	27.25
17	60	27.25
18	72	27.00
20	72	26.50
24	84	27.25

CARBON

8	60	14.25
10	60	13.80
12	60	14.75
14	60	14.75
14	72	12.55
17	60	12.65
17	72	12.10
20	90	11.55
24	72, 84	11.95
24	96	12.10
30	84	17.00
35, 40	110	11.60
40	100	12.50

Metal Powder

(Per pound, f.o.b. shipping point in ton lots for minus 100 mesh, except as noted.)

	Cents
Sponge Iron, domestic and foreign, 98% Fe, min. truckiots, freight allowed east of Mississippi River: 100 mesh, bags	11.50
100 mesh, pails	9.85‡
40 mesh, bags	8.10††
Electrolytic Iron,	
Melting stock, 99.9% Fe, irreg. fragments, ⅛ in. x 1.3 in.	28.75
(In contract lots of 750 tons price is 22.75c)	
Annealed, 99.5% Fe, 36.75, ton, del. east of Mississippi.	
Unannealed (99+% Fe)	33.0
Unannealed (99+% Fe) (minus 325 mesh)	58.0
Carbonyl Iron: 90-99.9%, 3 to 20 microns, depending on grade, 88.00-700.00 in standard 200-lb containers; all minus 200 mesh.	
Aluminum: Atomized, 600-lb drum freight allowed, c.l.	39.80; ton lots 41.80
Brass, 80/20, leaded (60 mesh)	39.90
Bronze filter powder, 90/10	47.00*
Cobalt, 50 mesh	1.58
Copper, all types	15.25*
Lead	7.50*
Manganese, minus 35 mesh	1.00
Nickel, all types	0.78-1.06
Nickel-Silver	60.70
Solder	15.00*
Stainless Steel, 304	89.00
Stainless Steel, 316	$1.07
Steel, AISI 4650	32.00
Tin	14.00*
Zinc	25.90

Cobalt:	Dollars
98.5%, minus 100-300 mesh	1.57-1.58
99.5%, below 5 microns	2.32
Tungsten: Carbon and hydrogen reduced, 98.8% min., minus 65 mesh	nom.**
Molybdenum	4.35

*Plus cost of metal. ‡Depending on mesh. §Cutting and scarfing grades. **Depending on price of ore. ††Welding grade.

Metallurgical Coke

Price per net ton

Beehive Ovens

Connellsville, Pa., furnace	$14.75-15.25
Connellsville, Pa., foundry	18.00-18.50

Oven Foundry

Birmingham, ovens	$30.35
Cincinnati, deld.	33.34
Buffalo, ovens	32.00
Chattanooga, Tenn., ovens	30.80
Detroit, ovens	32.00
Pontiac, Mich., deld.	33.95
Saginaw, Mich., deld.	35.53
Erie, Pa., ovens	32.00
Everett, Mass., ovens: New England, deld.	33.55*
Indianapolis, ovens	31.25
Ironton, Ohio, ovens	30.50
Cincinnati, deld.	33.54
Kearny, N. J., ovens	31.25
Milwaukee, ovens	32.00
Neville Island (Pittsburgh), Pa., ovens	30.75
Painesville, Ohio, ovens	32.00
Cleveland, deld.	34.35
Philadelphia, ovens	31.00
St. Louis, ovens	33.00
St. Paul ovens	31.25
Chicago, deld.	34.68
Swedeland, Pa., ovens	31.00
Terre Haute, Ind., Ovens	31.25

*Within $5.15 freight zone from works.

Imported Steel

(Base per 100 lb, landed, duty paid; based on current ocean rates with any rise for buyer's acc't. Source of shipment: Western Europe)

	North Atlantic	Great Lakes*	South Atlantic	Gulf Coast	West Coast
Deformed Bars, Intermediate, ASTM-A 305	$5.75	....	$5.65	$5.50	$5.85
Bar Size Angles	5.95	....	5.85	5.70	6.05
Structural Angles	5.95	....	5.65	5.50	5.85
I-Beams	5.70	....	5.60	5.45	5.80
Channels	5.70	....	5.60	5.45	5.80
Plates (basic bessemer)	5.85	....	5.75	5.60	5.95
Sheets, H.R.	Nom.	....	Nom.	Nom.	Nom.
Sheets, Galvanized, 20 Ga., 36 in. x 96 in.	Nom.	....	Nom.	Nom.	Nom.
Sheets, Galv. (in coils) 20 Ga., 48 in. wide	Nom.	....	Nom.	Nom.	Nom.
Furring Channels, C.R., 1000 ft, ⅞ x 0.30 lb per ft	25.50	....	24.70	24.70	25.50
Barbed Wire (†)	6.25	....	6.15	6.00	6.35
Merchant Bars	5.95	....	5.85	5.70	6.05
Hot-Rolled Bands	6.20	....	6.10	5.95	6.30
Wire Rods, Thomas Commercial No. 5	6.40	....	6.20	6.20	6.60
Wire Rods, O. H., No. 5	6.55	....	6.35	6.35	6.70
Bright Common Wire Nails (‡)	7.25	....	7.15	7.00	7.35

*Books closed for 1960-61 shipping season. †Per 82 lb net reel. ‡Per 100-lb keg, 20d nails and heavier.

Coal Chemicals

(Representative prices)

Cents per gal f.o.b. tank cars or tank trucks, plant.

Pure benzene	31.00
Xylene, industrial grade	29.00
Creosote	24.00
Naphthalene, 78 deg.	6.00
Toluene, one deg. (deld. east of Rockies)	25.00

Cents per lb, f.o.b. tank cars or tank trucks, deld.

Phenol, 90 per cent grade	14.75

Per net ton bulk, f.o.b. cars or truck, plant.

Ammonium sulfate, regular grade	$32.00

Ferroalloys

MANGANESE ALLOYS

Spiegeleisen: Carlot, 10 lb pigs, per gross ton, Palmerton, Pa. 21-23% Mn, $102.50; 19-21% Mn, 1-3% Si, $100; 16-19% Mn $98. For Neville Island, Pa., prices add $2.50 as of Feb. 1. Lump 35 lb and down: Deduct $2 from 10 lb pig prices at Palmerton.

Standard Ferromanganese: (Mn 74-76%, C 7% approx) base price per net ton, $220, Johnstown, Duquesne, Sheridan, Neville Island, Pa.; Alloy, W. Va., Ashtabula, Marietta, O.; Rockwood, Tenn.; Houston, Tex.; Sheffield, Ala.; Portland, Oreg. Add or subtract $2 for each 1% or fraction thereof of contained manganese over 76% or under 74%, respectively (Min 79-81%). Lump $228 per net ton, f.o.b. Anaconda, Mont. Add $2.60 for each 1% above 81%; subtract $2.60 for each 1% below 79%, fractions in proportion to nearest 0.1%.

High-Grade Low-Carbon Ferromanganese: (Mn 85-95%). Carload, lump, bulk, max 0.07% C, 35.1c per lb of contained Mn, carload packed 36.4c, ton lots 37.9c, less ton 39.1c. Delivered. Deduct 4c for max 0.15% C grade from above prices. 5.3c for max 0.03% C. 6.6c for max 0.5% C, and 8.1c for max 75% C—max 7% Si. **Special Grade:** (Mn 90% min, C 0.07% max, P 0.06% max). Add 2.05c to the above prices. Spot, add 0.25c.

Medium-Carbon Ferromanganese: (Mn 80-85%, C 1.25-1.5%, Si 1.5% max). Carload, lump, bulk, 24c per lb of contained Mn; packed, carload 25.3c, ton lot 26.9c, less ton 28.1c.

Electrolytic Manganese Metal: Min carload, bulk, 34.25c; 2000 lb to min carload, 37c; less ton, 39c; 50 lb cans, add 0.5c per lb. Premium for hydrogen-removed metal 0.75c per lb. Prices are f.o.b. cars, Knoxville, Tenn., freight allowed to St. Louis or any point east of Mississippi River; or f.o.b. Marietta, O., freight allowed.

Silicomanganese: (Mn 65-68%). Carload, lump, bulk, 1.50% C grade, 18.5-21% Si, 11.6c per lb of alloy. Packed, c.l. 12.8c, ton 13.25c, less ton 14.25c, f.o.b. Alloy, W. Va.; Ashtabula, Marietta, O.; Rockwood, Tenn.; Houston, Tex.; Sheffield, Ala.; Portland, Oreg. For 2% C grade, Si 16-18.5%, deduct 0.3c from above prices. For 3% grade, Si 12.5-16% deduct 0.5c from above prices. Spot, add 0.25c.

TITANIUM ALLOYS

Ferrotitanium, Low-Carbon: (Ti 20-25%, Al 3.5% max Si 4% max, C 0.10% max). Contract, ton lot, 2" x D, $1.50 per lb of contained Ti; less ton to 300 lb, $1.55. Ti 38-43%, Al 8% max, Si 4% max, C 0.10% max). Ton lot $1.35, less ton to 300 lb $1.37, f.o.b. Niagara Falls, N. Y., freight allowed to St. Louis.

Ferrotitanium, High-Carbon: (Ti 15-18%, C 6-8%). Contract min c.l. $250 per ton, f.o.b. Niagara Falls, N. Y., freight allowed to destinations east of Mississippi River and north of Baltimore and St. Louis. Spot, $255.

Ferrotitanium, Medium-Carbon: (Ti 17-21%, C 2-4%). Contract, c.l. $300 per ton, f.o.b. Niagara Falls, N. Y., freight not exceeding St. Louis rate allowed. Spot, $305.

CHROMIUM ALLOYS

High-Carbon Ferrochrome: C.l. lump, bulk, 28.75c per lb of contained Cr. Delivered.

Charge Chrome: Cr 50-56%, C 6-8%, Si 4-7%, 22.00c; Cr 58-63%, C 5-8%, Si 3-6%, 22.50c per lb of contained Cr, carlots, lump, bulk, delivered.

Blocking Chrome: Cr 55-63%, C 4-6%, Si 8-12%, 23.50c per lb of contained Cr, delivered in carlots, lump, bulk.

Refined Chrome: Cr 53-63%, C 3-5%, Si 2.5% max. 26.00c per lb of contained Cr, delivered in carlots, lump, bulk.

Low-Carbon Ferrochrome: Cr 63-66% (Simplex), carload, lump, bulk, C 0.025% max, 33.50c per lb contained Cr; 0.010% max, 34.50c. Delivered.

Cr, 65-71%, carload, lump, bulk, 0.025% max, 35.00c; 0.05% max, 34.00c; 0.10% max, 33.75c; 0.20% max, 33.50c; 0.50% max, 33.25c; 1.0% max, 33.00c; 1.5% max, 32.75c; 2.0% max, 32.50c. Delivered.

Foundry Ferrochrome, High-Carbon: (Cr 62-66%, C 5-7%, Si 7-10%). C.l., 2" x D, bulk 30.5c per lb of contained Cr. Packed, c.l. 32.4c, ton 34.2c, less ton 35.7c. Delivered. Spot, add 0.25c.

Foundry Ferrosilicon Chrome: (Cr 50-54%, Si 28-32%, C 1.25% max). SM x D, carload, bulk, 20.05c per lb of alloy carload packed 21.25c, ton lot 22.50c, less ton lot 23.70c. Delivered. Spot, add 0.25c.

Ferrochrome-Silicon: Cr 39-41%, Si 42-45%, C 0.05% max, 24.50c per lb contained Cr and 14.60c per lb contained Si; Cr 33-36%, Si 45-48%, C 0.05% max, 24.50c per lb contained Cr, 14.60c per lb contained Si; 0.75 in. x down, 26.25c per lb contained Cr, 14.60c per lb contained Si.

Chromium Metal, Electrolytic: Commercial grade (C 99.8% min, metallic basis Fe 0.2% max). Contract, carlot packed, 2" x D plate (above ⅛" thick) $1.15 per lb, ton lot $1.17, less ton lot $1.19. Delivered. Spot, add 5c.

VANADIUM ALLOYS

Ferrovanadium: Open hearth grade (V 50-55%, Si 8% max, C 3% max). Contract, any quantity, $3.20 per lb of contained V. Delivered. Spot, add 10c. **Special Grade:** (V 50-55% or 70-75%, Si 2% max, C 0.5% max) $3.30. **High Speed Grade:** (V 50-55% or 70-75%, Si 1.50% max, C 0.20% max) $3.40.

Grainal: Vanadium Grainal No. 1, $1.05 per lb; No. 79, 50c, freight allowed.

Vanadium Oxide: Contract, less carload lot, packed, $1.38 per lb contained V_2O_5 freight allowed. Spot, add 5c.

SILICON ALLOYS

50% Ferrosilicon: Carload, lump, bulk, 14.6c per lb contained Si. Packed, c.l. 17.1c, ton lot 18.55c, less ton 20.20c, f.o.b. Alloy, W. Va.; Ashtabula, Marietta, O.; Chattanooga, Rockwood, Tenn.; Houston, Tex.; Sheffield, Ala.; Keokuk, Iowa; Portland, Oreg. Spot, add 0.45c.

Low-Aluminum 50% Ferrosilicon: (Al 0.40% max). Add 1.45c to 50% ferrosilicon prices.

65% Ferrosilicon: Carload, lump, bulk, 15.75c per lb contained silicon. Packed, c.l. 17.75c, ton lot 19.55c, less ton 20.9c. Delivered. Spot, add 0.35c.

75% Ferrosilicon: Carload, lump, bulk, 16.9c per lb of contained Si. Packed, c.l. 18.8c, ton lot 20.45c, less ton 21.7c. Delivered. Spot, add 0.3c.

90% Ferrosilicon: Carload, lump, bulk, 20c per lb of contained Si. Packed, c.l. 21.65c, ton lot 23.05c, less ton 24.1c. Delivered. Spot, add 0.25c.

Silicon Metal: (98% min Si, 1.00% max Fe, 0.7% max Ca). C.l. lump, bulk, 21.5c per lb of Si. Packed, c.l. 23.15c, ton lot 24.45c, less ton 25.45c. Add 0.5c for max 0.03% Ca grade. Add 0.5c for 0.50% Fe grade analyzing 98.25% min Si.

Alsifer: (Approx 20% Al, 40% Si, 40% Fe). Contract, basis f.o.b. Niagara Falls, N. Y., lump, carload, bulk, 9.85c per lb of alloy; ton lots, packed, 10.85c.

ZIRCONIUM ALLOYS

12-15% Zirconium Alloy: (Zr 12-15%, Si 39-43%, C 0.20% max). Contract, c.l., lump, bulk, 9.25c per lb of alloy. Packed, c.l. 10.45c, ton lot 11.6c, less ton 12.45c. Delivered. Spot, add 0.25c.

35-40% Zirconium Alloy: (Zr 35-40%, Si 47-52%, Fe 8-12%, C 0.50% max). Carload, bulk, 26.25c per lb of alloy, carload, lump, packed 27.25c, ton lot 28.4c, less ton 29.65c. Freight allowed. Spot, add 0.25c.

BORON ALLOYS

Ferroboron: 100 lb or more packed (B 17.50% min, Si 1.50% max, Al 0.50% max, C 0.50% max). Contract, 100 lb or more 1" x D, $1.20 per lb of alloy; less than 100 lb $1.30. Delivered. Spot, add 5c. F.o.b. Washington, Pa., prices 100 lb and over are as follows: Grade A (10-14% B) 85c per lb; Grade B (14-18% B) $1.20; Grade C (19% min B) $1.50.

Borosil: (3 to 4% B, 40 to 45% Si). Carload, bulk, lump, or 3" x D, $5.25 per lb of contained B. Packed, carload, $5.40, ton to c.l. $5.50, less ton $5.60. Delivered.

Carbortam: (B 1 to 2%). Lump, carload $320 per ton, f.o.b. Suspension Bridge, N. Y., freight allowed same as high-carbon ferrotitanium.

CALCIUM ALLOYS

Calcium-Manganese-Silicon: (Ca 16-20%, Mn 14-18% and Si 53-59%). Carload, lump, bulk 23c per lb of alloy, carload packed 24.25c, ton lot 26.15c, less ton 27.15c. Delivered. Spot, add 0.25c.

Calcium-Silicon: (Ca 30-33%, Si 60-65%, Fe 1.5-3%). Carload, lump, bulk 24c per lb of alloy, carload packed 25.65c, ton lot 27.95c, less ton 29.45c. Delivered. Spot, add 0.25c.

BRIQUETTED ALLOYS

Chromium Briquets: (Weighing approx 3¾ lb each and containing 2 lb of Cr). Carload, bulk 19.60c per lb of briquet, in bags 20.70c; 3000 lb to c.l. pallets 20.80c; 2000 lb to c.l. in bags 21.90c; less than 2000 lb in bags 22.80c. Delivered. Spot, add 0.25c.

Ferromanganese Briquets: (Weighing approx 3 lb and containing 2 lb of Mn). Carload, bulk 13.7c per lb of briquet; c.l. packed, bags 14.9c; 3000 lb to c.l., pallets 14.9c; 2000 lb to c.l., bags 16.1c; less ton 17c. Delivered. Spot, add 0.25c.

Silicomanganese Briquets: (Weighing approx 3½ lb and containing 2 lb of Mn and approx ½ lb of Si). C.l. bulk 14c per lb briquet; c.l. packed, bags 15.2c; 3000 lb to c.l., pallets 15.2c; 2000 lb to c.l., bags 16.4c; less ton 17.3c. Delivered. Spot, add 0.25c.

Silicon Briquets: (Large size—weighing approx 5 lb and containing 2 lb of Si and small sizes, weighing approx 2½ lb and containing 1 lb of Si). Carload, bulk 8c per lb of briquet; packed, bags 9.2c; 3000 lb to c.l., pallets 9.6c; 2000 lb to c.l., bags 10.8c; less ton 11.7c. Delivered. Spot, add 0.25c.

Molybdic-Oxide Briquets: (Containing 2½ lb of Mo each). $1.49 per lb of Mo contained, f.o.b. Langeloth, Pa.

Titanium Briquets: Ti 98.27%, $1 per lb f.o.b. Niagara Falls, N. Y.

TUNGSTEN ALLOYS

Ferrotungsten: (70-80%). 5000 lb W or more $2.15 per lb (nominal) of contained W. Delivered.

OTHER FERROALLOYS

Ferrocolumbium: (Cb 50-60%, Si 4% max, C 0.1% max). Ton lots 2" x D, $3.45 per lb of contained Cb; less ton lots $3.50 (nominal). Delivered.

Ferrotantalum Columbium: (Cb 44-77% approx, Ta 15% approx, and Cb plus Ta 60% min, C 0.30% max). Ton lots 2" x D, $3.05 per lb of contained Cb plus Ta, delivered; less ton lots, $3.10.

SMZ Alloy: (Si 60-65%, Mn 5-7%, Zr 5-7%, Fe 20% approx). Carload, bulk 19.25c per lb of alloy, c.l. packed ½ in. x 12 M 20.00c, ton lot 21.15c, less ton 22.40c. Delivered. Spot, add 0.25c.

Graphidox No. 4: (Si 48-52%, Ca 5-7%, Ti 9-11%). C.l. packed, 20% per lb of alloy, ton lot 21.15c; less ton lot 22.4c, f.o.b. Niagara Falls, N. Y., freight allowed to St. Louis.

V-5 Foundry Alloy: (Cr 38-42%, Si 17-19%, Mn 8-11%). C.l. packed 18.45c per lb of alloy; ton lot 19.95c; less ton lot 21.20c, f.o.b. Niagara Falls, N. Y., freight allowed to St. Louis.

Simanal: (Approx 20% each Si, Mn, Al; bal Fe). Lump, carload, bulk, 19.25c. Packed c.l. 20.25c; 2000 lb to c.l. 21.25c; less than 2000 lb 21.75c per lb of alloy. Delivered.

Ferrophosphorus: (23-25% based on 24% P content with unitage of $5 for each 1% of P above or below the base). Carload, bulk, f.o.b. sellers' works, Mt. Pleasant, Sigio, Tenn., $120 per gross ton.

Ferromolybdenum: (65-75%). Per lb of contained Mo in 200-lb container, f.o.b. Langeloth and Washington, Pa., $1.76 in all sizes except powdered which is $1.82.

Technical Molybdic-Oxide: Per lb of contained Mo, in cans $1.47; in bags, $1.46, f.o.b. Langeloth and Washington, Pa.

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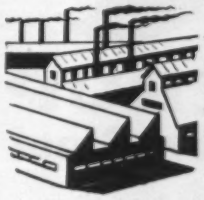

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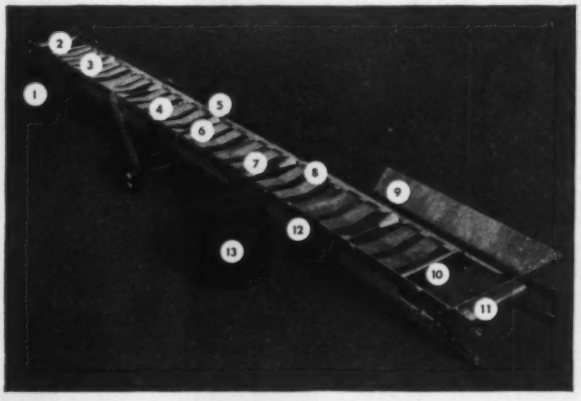

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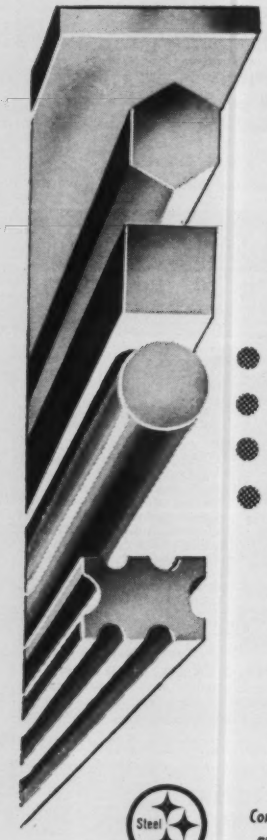

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S4

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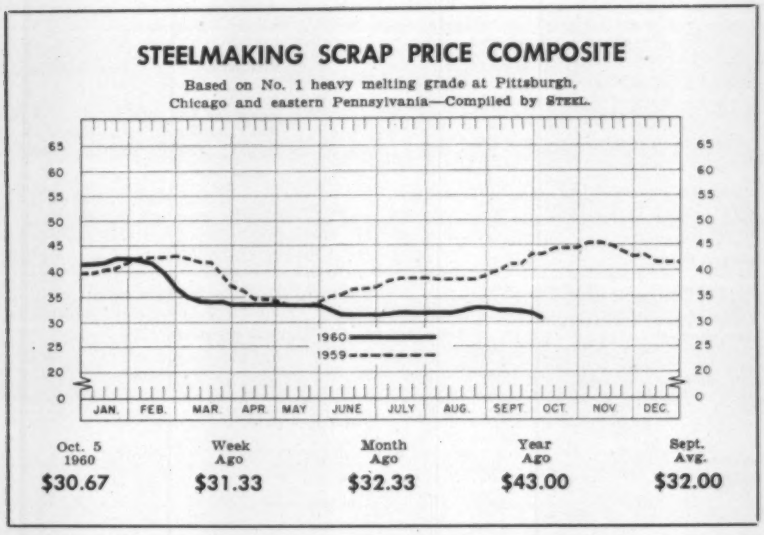


Scrap Lacks Buying Support

STEEL's composite on No. 1 heavy melting steel declines another 66 cents a ton to $30.67, lowest since September, 1954. Uptrend in steelmaking not yet in sight

Scrap Prices, Page 242

• **Chicago**—Lack of trading is holding scrap prices essentially unchanged, but the market is weak. A leading mill, which during September paid $32 a gross ton for No. 1 industrial heavy melting accepted as returns from customers, last week announced $30 as its price for that material during October.

• **New York**—Domestic trading is still slowing down, and export demand is also somewhat easier, though active enough to give the market on the major open hearth grades some support.

• **Philadelphia** — Weakness still dominates the local market. With export trading off and with little domestic buying, the market on most steel grades is scarcely more than nominal.

• **St. Louis** — Virtually all scrap grades are quoted off $1 to $2 a ton here. Prices reflect the withdrawal of Chicago buyers from this market—probably for the next 30 days.

• **Cincinnati**—Prices on the principal steelmaking grades are off $1-$1.50 a ton in brokers' lists. A local mill entered the market for limited tonnage. No. 1 heavy melting is quoted $24.50-$25.50.

• **Pittsburgh**—Scrap prices are off $2 to $3 across the board in a soft market. Brokers for a mill on the edge of the district paid dealers $29 a ton, delivered, for No. 1 heavy melting—$2 less than last month. Earlier, the local plant of GM's Fisher Body Div. sold No. 1 factory bundles to brokers at an average price of $33 (vs. $36.15 a month ago). B&O Railroad got $35.20 for No. 1 heavy melting sold for export but was offered only $31.50 by domestic buyers. Wheels fell $5.64 a ton to $38.11.

• **Cleveland**—Failure of steel production to make significant gains is depressing the scrap market here and in the Valley. With only small tonnages moving, prices are weak and largely untested. Weakness has been especially noticeable since the sharp price decline on the auto lists at the start of the month.

• **Buffalo**—Prices on the principal open hearth grades of scrap have been reduced $2 a ton. Turnings are off $1.

• **Houston**—Prices on steel scrap are holding, but they are on a shaky foundation. Neither mills nor foundries are doing much buying.

• **Birmingham**—Prices are holding, and some dealers anticipate a pick-up in buying soon, particularly of the electric furnace grades.

• **San Francisco**—The Japanese are expected to take about 26 cargoes of scrap from Pacific Coast ports during the fourth quarter. The tonnage will be down about 24 per cent from that taken in the third quarter. Domestic demand continues to lag.

• **Los Angeles**—The recent reduction in prices negotiated by the Japanese on their fourth quarter purchases has done little to perk up demand. Local buyers are few, and they are insisting that the lower prices quoted the Japanese apply throughout the list of items, not just the three items to be exported. Dealers say enough material is on hand to take care of the Japanese orders for the next 30 to 40 days.

• **Seattle** — Prices are unchanged. The mills are carrying large inventories and not much material is moving.

Scrap Exports Continue Uptrend During July

Exports of iron and steel scrap in July totaled 593,534 net tons (valued at $17,049,322), reports the Commerce Department. That compares with 497,327 tons (valued at $16,199,576) exported in July, 1959. The total exports for the first seven months this year was 3,741,873 tons (valued at $123,217,947), compared with 2,395,356 tons (valued at $78,228,275).

Scrap imports in July totaled 18,639 net tons (valued at $545,315), and compared with 27,588 tons (valued at $982,283) in the same month last year. Imports in the first seven months this year amounted to 113,119 tons (valued at $4,146,612). In the same period last year, the total was 181,012 tons (valued at $6,763,030).

Iron and Steel Scrap

Consumer prices per gross ton, except as otherwise noted, including brokers' commission, as reported to STEEL, Oct. 5, 1960. *Changes shown in italics.*

STEELMAKING SCRAP COMPOSITE

Oct. 5	$30.67
Sept. 28	31.33
Sept. Avg.	32.00
Oct. 1959	44.00
Oct. 1955	45.17

Based on No. 1 heavy melting grade at Pittsburgh, Chicago, and eastern Pennsylvania.

PITTSBURGH

No. 1 heavy melting	*28.00-29.00*
No. 2 heavy melting	*24.00-25.00*
No. 1 dealer bundles	*29.00-30.00*
No. 2 bundles	*22.00-23.00*
No. 1 busheling	*28.00-29.00*
No. 1 factory bundles	*35.00-36.00*
Machine shop turnings	*13.00-14.00*
Mixed borings, turnings	*13.00-14.00*
Short turnings	*17.00-18.00*
Cast iron borings	*17.00-18.00*
Cut structurals:	
2 ft and under	*34.00-35.00*
3 ft and under	*33.00-34.00*
Heavy turnings	27.00-28.00
Punchings & plate scrap	*36.00-37.00*
Electric furnace bundles	*35.00-36.00*

Cast Iron Grades

No. 1 cupola	38.00-39.00
Stove plate	*32.00-33.00*
Unstripped motor blocks	*22.00-23.00*
Clean auto cast	*36.00-37.00*
Drop broken machinery	47.00-48.00

Railroad Scrap

No. 1 R.R. heavy melt.	*32.00-33.00*
Rails, 2 ft and under	*48.00-49.00*
Rails, 18 in. and under	*49.00-50.00*
Random rails	*44.00-45.00*
Angles, splice bars	*43.00-44.00*
Railroad specialties	*38.00-39.00*
Rails, rerolling	53.00-54.00

Stainless Steel Scrap

18-8 bundles & solids	175.00-180.00
18-8 turnings	95.00-100.00
430 bundles & solids	90.00-95.00
430 turnings	50.00-55.00

CHICAGO

No. 1 hvy melt., indus.	29.00-30.00
No. 1 hvy melt., dealer	27.00-28.00
No. 2 hvy melting	25.00-26.00
No. 1 factory bundles	*31.00-32.00*
No. 1 dealer bundles	28.00-29.00
No. 2 bundles	16.00-17.00
No. 1 busheling, indus.	29.00-30.00
No. 1 busheling, dealer	27.00-28.00
Machine shop turnings	12.00-13.00
Mixed borings, turnings	14.00-15.00
Shovel turnings	14.00-15.00
Cast iron borings	14.00-15.00
Cut structurals, 3 ft	32.00-33.00
Punchings & plate scrap	34.00-35.00

Cast Iron Grades

No. 1 cupola	38.00-39.00
Stove plate	32.00-33.00
Unstripped motor blocks	30.00-31.00
Clean auto cast	43.00-44.00
Drop broken machinery	43.00-44.00

Railroad Scrap

No. 1 R.R. heavy melt.	*31.00-32.00*
R.R. malleable	42.00-43.00
Rails, 2 ft and under	44.00-45.00
Rails, 18 in. and under	45.00-46.00
Angles, splice bars	38.00-39.00
Axles	52.00-53.00
Rails, rerolling	52.00-53.00

Stainless Steel Scrap

18-8 bundles, solids	170.00-175.00
18-8 turnings	85.00-90.00
430 bundles & solids	80.00-85.00
430 turnings	40.00-45.00

DETROIT

(Brokers' buying prices; f.o.b. shipping point)

No. 1 heavy melting	21.00-22.00
No. 2 heavy melting	16.00-17.00
No. 1 bundles	24.00-25.00
No. 2 bundles	13.00-14.00
No. 1 busheling	20.00-21.00
Machine shop turnings	7.00-8.00
Mixed borings, turnings	9.00-10.00
Shovel turnings	9.00-10.00

Cast Iron Grades

No. 1 cupola	32.00-33.00
Stove plate	25.00-26.00
Heavy breakable	25.00-26.00
Unstripped motor blocks	19.00-20.00
Charging box cast	25.00-26.00
Clean auto cast	40.00-41.00

CLEVELAND

No. 1 heavy melting	*28.00-29.00*
No. 2 heavy melting	*20.00-21.00*
No. 1 factory bundles	*30.00-31.00*
No. 1 bundles	*28.00-29.00*
No. 2 bundles	*16.00-17.00*
No. 1 busheling	*28.00-29.00*
Machine shop turnings	10.00-11.00
Shovel turnings	14.00-15.00
Mixed borings, turnings	14.00-15.00
Cast iron borings	14.00-15.00
Cut foundry steel	*31.00-32.00*
Cut structurals, plate 2 ft and under	35.00-36.00
Low phos. punchings & plate	*28.50-29.50*
Alloy free, short shovel turnings	*15.00-16.00*
Electric furnace bundles	*28.50-29.50*

Cast Iron Grades

No. 1 cupola	42.00-43.00
Charging box cast	31.00-32.00
Heavy breakable cast	28.00-29.00
Stove plate	37.00-38.00
Unstripped motor blocks	30.00-31.00
Brake shoes	35.00-36.00
Clean auto cast	47.00-48.00
Burnt cast	38.00-39.00
Drop broken machinery	48.00-49.00

Railroad Scrap

R.R. malleable	45.00-46.00
Rails, 2 ft and under	48.00-49.00
Rails, 18 in. and under	49.00-50.00
Rails, random length	42.00-43.00
Cast steel	36.00-37.00
No. 1 railroad cast	*43.00-44.00*
Railroad specialties	*39.00-40.00*
Angles, splice bars	*41.00-42.00*
Rails, rerolling	53.00-54.00

Stainless Steel Scrap

(Brokers' buying prices; f.o.b. shipping point)

18-8 bundles, solids	165.00-170.00
18-8 turnings	75.00-80.00
430 clips, bundles, solids	85.00-90.00
430 turnings	20.00-30.00†

YOUNGSTOWN

No. 1 heavy melting	*30.00-31.00*
No. 2 heavy melting	*21.00-22.00*
No. 1 busheling	*30.00-31.00*
No. 1 bundles	*30.00-31.00*
No. 2 bundles	*19.00-20.00*
Machine shop turnings	*12.00-13.00*
Shovel turnings	*14.00-15.00*
Cast iron borings	*17.00-18.00*
Low phos.	*32.00-33.00*
Electric furnace bundles	*32.00-33.00*

Railroad Scrap

No. 1 R.R. heavy melt.	*32.50-33.50*

BUFFALO

No. 1 heavy melting	*27.00-28.00*
No. 2 heavy melting	*22.00-23.00*
No. 1 bundles	*27.00-28.00*
No. 2 bundles	*19.00-20.00*
No. 1 busheling	*27.00-28.00*
Shovel turnings	*15.00-16.00*
Machine shop turnings	*11.00-12.00*
Cast iron borings	*13.00-14.00*
Low phos. structurals and plate, 2 ft and under	*35.00-36.00*

Cast Iron Grades

(F.o.b. shipping point)

No. 1 cupola	*39.00-40.00*
No. 1 machinery	*46.00-47.00*

Railroad Scrap

Rails, random lengths	*39.00-40.00*
Rails, 3 ft and under	*45.00-46.00*
Railroad specialties	*38.00-39.00*

CINCINNATI

(Brokers' buying prices; f.o.b. shipping point)

No. 1 heavy melting	*24.50-25.50*
No. 2 heavy melting	*20.50-21.50*
No. 1 bundles	*24.50-25.50*
No. 2 bundles	*16.00-17.00*
No. 1 busheling	*24.50-25.50*
Machine shop turnings	*8.00-9.00*
Mixed borings, turnings	*8.00-9.00*
Shovel turnings	*11.00-12.00*
Cast iron borings	*11.00-12.00*
Low phos. 18 in.	*33.00-34.00*

Cast Iron Grades

No. 1 cupola	36.00-37.00
Heavy breakable cast	*29.00-30.00*
Charging box cast	35.00-36.00
Drop broken machinery	*46.00-47.00*

Railroad Scrap

No. 1 R.R. heavy melt.	*31.00-32.00*
Rails, 18 in. and under	*47.00-48.00*
Rails, random lengths	*40.00-41.00*

PHILADELPHIA

No. 1 heavy melting	35.00
No. 2 heavy melting	31.00
No. 1 bundles	36.00
No. 2 bundles	21.00
No. 1 busheling	36.00
Electric furnace bundles	37.00
Mixed borings, turnings	17.00†
Shovel turnings	21.00
Machine shop turnings	15.00
Heavy turnings	28.00†
Structurals & plates	38.00-40.00
Couplers, springs, wheels	40.00
Rail crops, 2 ft & under	*50.00-51.00*

Cast Iron Grades

No. 1 cupola	39.00
Heavy breakable cast	38.00
Drop broken machinery	49.00-50.00
Malleable	46.00

NEW YORK

(Brokers' buying prices)

No. 1 heavy melting	30.00-31.00
No. 2 heavy melting	21.00-22.00
No. 1 bundles	30.00-31.00
No. 2 bundles	16.00-17.00
Machine shop turnings	*6.00-7.00*
Mixed borings, turnings	*7.00-8.00*
Shovel turnings	*8.00-9.00*
Low phos. structurals & plates	33.00-34.00†

Cast Iron Grades

No. 1 cupola	36.00-37.00
Unstripped motor blocks	25.00-26.00
Heavy breakable	30.00-31.00

Stainless Steel

18-8 sheets, clips, solids	*155.00-165.00*
18-8 borings, turnings	80.00-85.00
410 sheets, clips, solids	55.00-60.00
430 sheets, clips, solids	70.00-75.00

BOSTON

(Brokers' buying prices; f.o.b. shipping point)

No. 1 heavy melting	26.00-27.00
No. 2 heavy melting	20.00-21.00
No. 1 bundles	26.00-27.00
No. 1 busheling	26.00-27.00
Machine shop turnings	6.00-7.00
Shovel turnings	9.00-9.50
No. 1 cast	39.00-40.00
Mixed cupola cast	30.00-30.50
No. 1 machinery cast	40.00-42.00

BIRMINGHAM

No. 1 heavy melting	30.00-31.00
No. 2 heavy melting	24.00-25.00
No. 1 bundles	29.00-30.00
No. 2 bundles	20.00-21.00
No. 1 busheling	31.00-32.00
Cast iron borings	10.00-11.00
Machine shop turnings	17.00-18.00
Shovel turnings	19.00-20.00
Bar crops and plate	38.00-39.00
Structurals & plate	38.00-39.00
Electric furnace bundles	32.00-33.00
Electric furnace:	
3 ft and under	35.00-36.00
2 ft and under	35.00-36.00

Cast Iron Grades

No. 1 cupola	48.00-49.00
Stove plate	47.00-48.00
Unstripped motor blocks	35.00-36.00
No. 1 wheels	37.00-38.00

Railroad Scrap

No. 1 R.R. heavy melt.	34.00-35.00
Rails, 18 in. and under	45.00-46.00
Rails, random lengths	39.00-40.00
Angles, splice bars	39.00-40.00

ST. LOUIS

(Brokers' buying prices)

No. 1 heavy melting	*28.00*
No. 2 heavy melting	*26.00*
No. 1 bundles	*30.00*
No. 2 bundles	*19.00*
No. 1 busheling	*29.00*
Machine shop turnings	7.50
Shovel turnings	9.50

Cast Iron Grades

No. 1 cupola	*42.00*
Charging box cast	*35.00*
Heavy breakable cast	34.00
Unstripped motor blocks	35.00
Clean auto cast	*42.00*
Stove plate	*36.50*

Railroad Scrap

No. 1 R.R. heavy melt.	*31.00*
Rails, random lengths	*36.00*
Rails, rerolling	*50.00*
Rails, 18 in. and under	*39.00*
Angles, splice bars	*36.00*

HOUSTON

(Brokers' buying prices; f.o.b. car)

No. 1 heavy melting	34.00
No. 2 heavy melting	31.00
No. 2 bundles	20.00-21.00†
Machine shop turnings	nom.
Low phos. plate & structurals:	
3 ft	37.00
2 ft and under	40.00-41.00

Cast Iron Grades

No. 1 cupola	34.00-34.50
Heavy breakable	25.00
Foundry malleable	31.00†
Unstripped motor blocks	28.00-28.50

Railroad Scrap

No. 1 R.R. heavy melt.	34.00-35.00

LOS ANGELES

No. 1 heavy melting	*30.00**
No. 2 heavy melting	*27.00*
No. 1 bundles	*25.00**
No. 2 bundles	*15.00**
Machine shop turnings	*11.00*
Shovel turnings	*13.00*
Cast iron borings	*13.00*
Cut structurals and plate 1 ft and under	44.00†

Cast Iron Grades

No. 1 cupola	39.00-44.00†

Railroad Scrap

No. 1 R.R. heavy melt.	39.00†

PORTLAND, OREG.

(Prepared, f.o.b. car)

No. 1 heavy melting	36.00-39.00
No. 2 heavy melting	33.00-36.00
No. 2 bundles	20.00
Shovel turnings	15.00
Electric furnace bundles	48.00

Cast Iron Grades

No. 1 cupola	35.00
Heavy breakable	33.00
Unstripped motor blocks	33.00
Stove plate (f.o.b. plant)	20.00

SEATTLE

(Prepared, f.o.b. car)

No. 1 heavy melting	38.50
No. 2 (prepared for shears)	30.00
No. 1 hvy (unprepared)	35.00
No. 2 heavy melting	35.50
No. 2 hvy (unprepared)	33.00
No. 1 (prepared for shears)	33.00
No. 2 bundles	23.00
Shovel turnings	15.00
Electric furnace bundles	48.00

Cast Iron Grades

No. 1 cupola	35.00
Heavy breakable cast	36.00
Unstripped motor blocks	33.00
Stove plate (f.o.b. plant)	20.00

SAN FRANCISCO

No. 1 heavy melting	34.00
No. 2 heavy melting	30.00
No. 1 bundles	30.00
No. 2 bundles	20.00
Machine shop turnings	14.00
Mixed borings, turnings	14.00
Cast iron borings	14.00
Heavy turnings	14.00
Shovel turnings	14.00
Cut structurals, 3 ft	40.00

Cast Iron Grades

No. 1 cupola	48.00
Charging box cast	34.00
Stove plate	34.00
Heavy breakable cast	28.00
Unstripped motor blocks	31.00
Clean auto cast	40.00
Drop broken machinery	40.00
No. 1 wheels	34.00

HAMILTON, ONT.

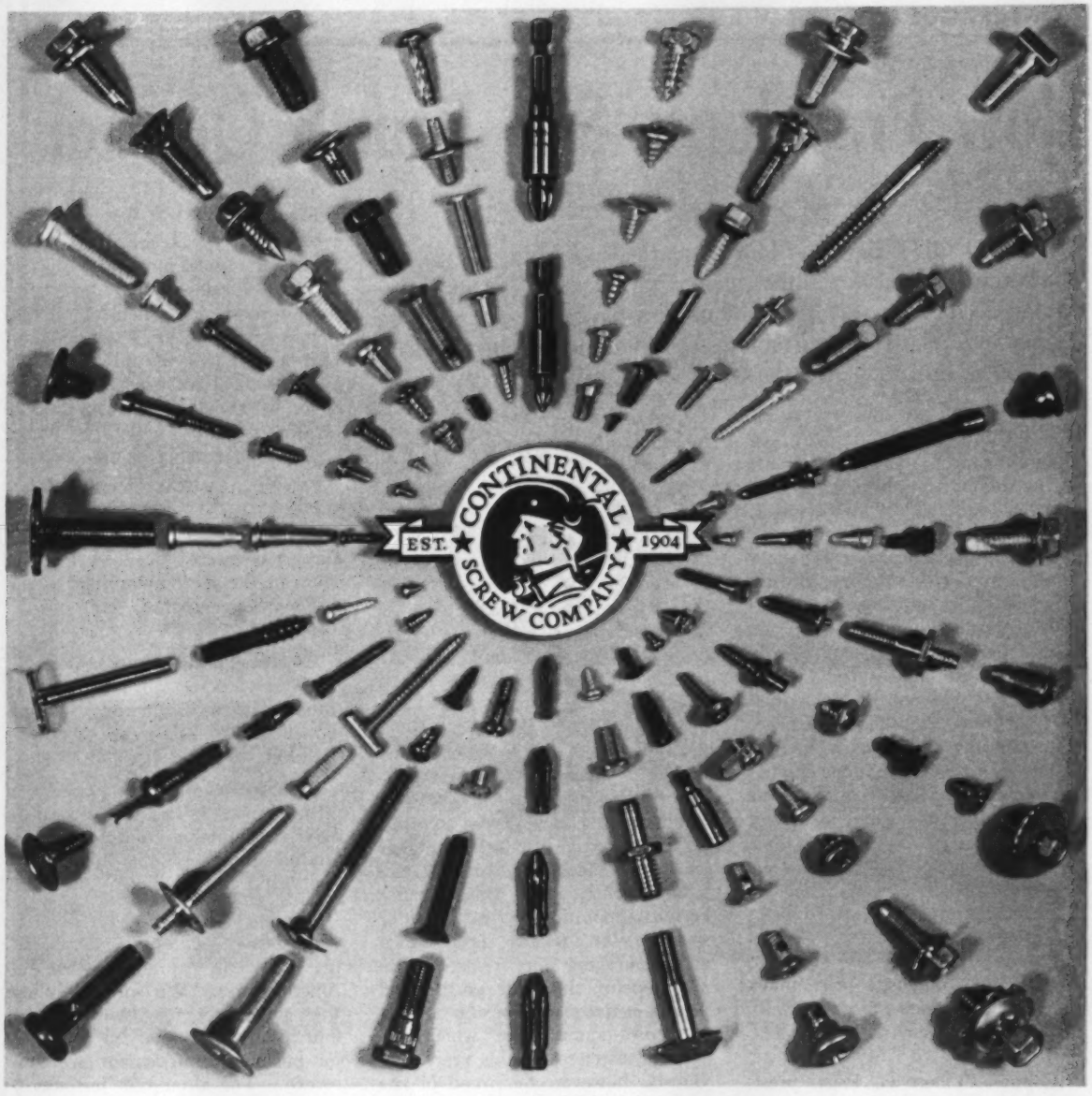
(Brokers' buying prices; net tons)

No. 1 heavy melting	25.80
No. 2 hvy melt, 2 ft & under	25.50
No. 1 bundles	25.80
No. 2 bundles	19.00
Mixed steel scrap	16.00
Mixed borings, turnings	12.00
Busheling, new factory:	
Prepared	25.50
Unprepared	20.45
Shovel turnings	12.00

Cast Iron Grades‡

No. 1 machinery cast	43.00

*For export add $4 dock charges.
†Nominal.
‡F.o.b. Hamilton, Ont.



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HY-PRO PHILLIPS INSERT BITS AND HOLDERS

How Presidents See Fourth Quarter

Nonferrous Metal Prices, Pages 246 & 247

TO FIND OUT how the fourth quarter is shaping up in the nonferrous industry, STEEL queried presidents of major companies. Their general observations and forecasts: No upsurge in demand, relative price stability, continued uncertainty. Here, in detail, is how they view the remainder of the quarter, and why.

• **Titanium**—E. R. Rowley, president, Titanium Metals Corp. of America, says: "Titanium shipments during the fourth quarter may come close to doubling last year's fourth quarter figure of 1.5 million lb.

"This rather sharp upturn should result in an over-all increase in shipments of 25 per cent over last year's.

"The current improvement is tied to new callouts for jet engines and fighter planes, such as the Chance Vought F8U-2N and the McDonnell F4H. Other significant market factors in the 1960 picture include metal (consumed) in development programs for cryogenic applications and solid fuel missiles. The use of titanium for pressure vessels in liquid fuel missiles appears to be growing.

"The continued downward price movement has been a factor in the increased utilization of titanium. The TMCA composite price index of titanium, which stood at $7.22 at the close of 1959, is now $6.97."

• **Copper**—Robert G. Page, president, Phelps Dodge Corp., says: "The outlook for copper in the fourth quarter can only be described as uncertain. World production and consumption figures for the first nine months demonstrate that there is excess productive capacity in the world, perhaps something on the order of 10 per cent. Accordingly, some curtailment in production would be in order if, and it is a big IF, there are no other interferences with production.

"For several months, the copper market has been influenced by fear of interruptions of production at the Katanga properties in the Congo and by the possibility of a strike at the Anaconda mine at Chuquicamata, Chile. The two properties contribute more than 50,000 tons per month, or about 16 per cent of world production.

"To date, there has apparently been no important interference with the Congo production. The strike at Chuquicamata took place Oct. 1. Its duration is uncertain. Unless the strike lasts far longer than is likely, it is probable that the industry will be forced to some measure of curtailment during the fourth quarter."

• **Lead**—J. D. MacKenzie, chairman and president, American Smelting & Refining Co., says: "The fourth quarter of the year is traditionally a period of relatively higher lead consumption. Although demand in this country this year has been disappointing, orders placed for shipment in October have shown an encouraging improvement. We are hopeful this will persist and permit maintenance of the present 12 cent-a-pound price, which has been in effect so far this year. Obviously, however, the trend of the lead market will be determined by general economic conditions."

• **Magnesium**—Dr. Leland I. Doan, president, Dow Chemical Co., says: "Magnesium sales have been affected by the slowdown that has confronted most of the metal industry. It now appears that Dow's magnesium sales (in comparison with those of like 1959 periods) will be down by about 20 per cent in the last three months of 1960 and down about 15 per cent for the year.

"Metal usage (is) about the same (as last year's). (Dow's sales are down because a) new primary producer has entered the field and because of the large amount of scrap put on the market by the government.

"Magnesium diecasting is increasing, and we expect this trend to continue. Through September, sales of our diecasting alloys had doubled those of 1959.

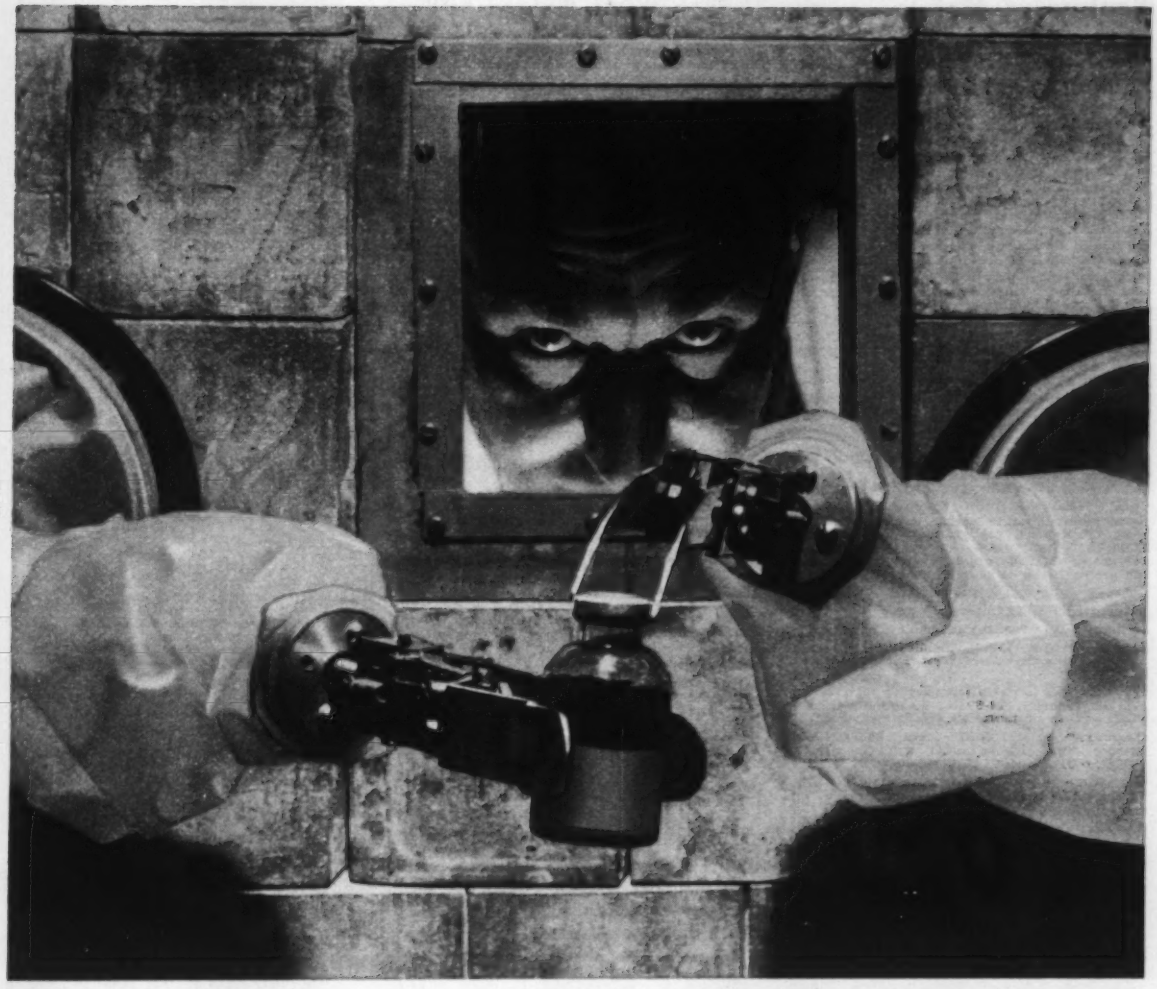
"We expect no change in the price of magnesium, and our production facilities are ample to meet any demand foreseeable in the next few years."

• **Aluminum**—Lawrence Litchfield Jr., president, Aluminum Co. of America, says: "We can't really say that we see a rosy glow in the fourth quarter as far as prospects for business improvement are concerned. The aluminum business is on a plateau, and we can't see anything (that will) get us on the up-

NONFERROUS PRICE RECORD

	Oct. 5 Price	Last Change	Previous Price	Sept. Avg	Aug. Avg	Oct., 1959 Avg
Aluminum	26.00	Dec. 17, 1959	24.70	26.000	26.000	24.700
Copper	31.00–33.00	Oct. 3, 1960	33.00	33.000	33.000	31.278
Lead	11.80	Dec. 21, 1959	12.30	11.800	11.800	12.800
Magnesium	35.25	Aug. 13, 1956	33.75	35.250	35.250	35.250
Nickel	74.00	Dec. 6, 1956	64.50	74.000	74.000	74.000
Tin	103.125	Oct. 5, 1960	102.875	102.355	102.815	102.231
Zinc	13.00	Jan. 8, 1960	12.50	13.000	13.000	12.500

Quotations in cents per pound based on: COPPER, mean of primary and secondary, deld. Conn. Valley; LEAD, common grade, deld. St. Louis; ZINC, prime western, E. St. Louis; TIN, Straits, deld. New York; NICKEL, electrolytic cathodes, 99.9%, base size at refinery, unpacked; ALUMINUM, primary ingot, 99.5+%, f.o.b. customer custody; MAGNESIUM, pig, 99.8%, Velasco, Tex.



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A JOHNSON MATTHEY ASSOCIATE "METALS FOR PRECISION AND PERFORMANCE"

Nonferrous Metals

Cents per pound, carlots except as otherwise noted.

PRIMARY METALS AND ALLOYS

Aluminum: 99.5%, 50 lb ingots, 26.00, 30,000 lb or more, f.o.b. customer custody.

Aluminum Alloy: No. 13, 25.90; No. 43, 26.20; No. 195, 27.60; No. 214, 31.50; No. 356, 26.80, 50 lb ingots.

Antimony: R.M.M. brand, 99.5%, 29.00; Lone Star brand, 29.50, f.o.b. Laredo, Tex., in bulk. Foreign brands, 99.5%, 25.50-26.00, New York, duty paid, 10,000 lb or more.

Beryllium: 97% lump or beads, $70.00 per lb, f.o.b. Cleveland or Reading, Pa.

Beryllium Aluminum: 5% Be, $65 per lb of contained Be, with balance as Al at market price, f.o.b. shipping point.

Beryllium Copper: 3.75-4.75% Be, $43 per lb of contained Be, with balance as Cu at market price on shipment date, f.o.b. shipping point.

Bismuth: $2.25 per lb, ton lots.

Cadmium: Sticks and bars, $1.60 per lb deld.

Cobalt: 99+%, $1.50 per lb for 500-lb keg; $1.52 per lb for 100 lb case; $1.57 per lb under 100 lb.

Columbium: Powder, $55-85 per lb nom.

Copper: Electrolytic, 33.00 deld.; custom smelters, 31.00; lake, 33.00 deld.; fire refined, 32.75 deld.

Germanium: First reduction, ingots, less than 1 kg, 36.00-37.50 per gram; 1-10 kg, 30.50-32.00 per gram; 10 kg or more, 28.10-29.99 per gram; intrinsic grade, under 10 kg, 31.95 per gram; 10 kg or more, 29.95 per gram.

Gold: U. S. Treasury, $35 per oz.

Indium: 99.9%, $2.25 per troy oz.

Iridium: $70-75 per troy oz nom.

Lead: Common, 11.80; chemical, 11.90; corroding, 11.90, St. Louis. New York basis, add 0.20.

Lithium: 1 lb or 2 lb ingots, less than 24 lb, $11 per lb deld.; 24-99 lb, $9.50; 100-499 lb, $9.25; 450 lb or more, $9 per lb, delivered.

Magnesium: Pig, 35.25; ingot, 36.00 f.o.b. Velasco, Tex., 1.3 in. diam. x 12 in. sticks, 57.00 f.o.b. Madison, Ill.

Magnesium Alloy: AZ91A (diecasting), 40.75; AZ63A, AZ92A, AZ91C (sand casting), 40.75, f.o.b. Velasco, Tex.

Mercury: Open market, spot, New York, $208-210 per 75 lb flask.

Molybdenum: Unalloyed forging billets, 4.125-8.5 in. diam., 50-4999 lb, $8.15-11.50 per lb, depending on quantity; 5000 lb or more, $8 per lb, f.o.b. Coldwater, Mich.

Nickel: Electrolytic cathodes, sheets (4 x 4 in. and larger), unpacked, 74.00; 10-lb pigs, unpacked, 78.25; "XX" nickel shot, 79.50; "F" nickel shot for addition to cast iron, in kegs, 74.50; "F" nickel, 5 lb ingots, 75.50. Prices f.o.b. Port Colborne, Ont., including import duty. New York basis, add 1.01. Nickel oxide sinter at Buffalo, New York, or other established U. S. ports of entry, contained nickel, 69.60.

Osmium: $70-90 per troy oz nom.

Palladium: $24-26 per troy oz.

Platinum: $82-85 per troy oz from refineries.

Radium: $16-21.50 per mg radium content, depending on quantity.

Rhodium: $137-140 per troy oz.

Ruthenium: $55-60 per troy oz.

Selenium: $6.50-7 per lb, commercial grade.

Silver: Open market, 91.375 per troy oz.

Sodium: Solid pack, c.l., 19.50; l.c.l., 20.00; brick, c.l., 21.00; l.c.l., 21.50; tank car, 17.00.

Tantalum: Melting stock, $35 per lb; rod, $60 per lb nom; sheet, $55 per lb nom.

Tellurium: $3.50-5 per lb, 100 lb or more.

Thallium: $7.50 per lb.

Tin: Straits, N. Y., spot and prompt, 103.125.

Titanium: Sponge, 99.3+% grade A-1, ductile (0.3% Fe max.), $1.60 per lb; grade A-2 (0.5% Fe max.), $1.50 per lb.

Tungsten: Powder, 98.8%, carbon reduced, 1000-lb lots, $2.75-2.90 per lb nom., f.o.b. shipping point; less than 1000 lb, add 15.00; 99+% hydrogen reduced, $3.10.

Zinc: Prime western, 13.00; brass special, 13.25; intermediate, 13.00, East St. Louis, freight allowed over 0.50 per lb, New York basis, add 0.50. High grade, 14.35; special high grade, 14.50 deld. Diecasting alloy ingot No. 3, 16.25; No. 2, 16.75; No. 5, 16.50 deld.

Zirconium: Reactor grade sponge, 100 lb or less, $8-8.50 per lb; 100-500 lb, $7.25-7.50 per lb; 500-1000 lb, $6.50-7.25; over 1000 lb, $6.50 per lb.

(Note: Chromium, manganese, and silicon metals are listed in ferroalloy section.)

SECONDARY METALS AND ALLOYS

Aluminum Ingot: Piston alloys, 25.00-26.00; No. 12 foundry alloy (No. 2 grade), 22.75; 5% silicon alloy, 0.60 Cu max., 24.00; 13 alloy, 0.60 Cu max., 24.00; 195 alloy, 25.75; 108 alloy, 23.25. Steel deoxidizing grades, notch bars, granulated or shot: Grade 1, 23.75; grade 2, 22.50; grade 3, 21.50; grade 4, 21.00.

Brass Ingot: Red brass, No. 115, 29.25; tin bronze, No. 225, 39.50; No. 245, 34.00; high-leaded tin bronze, No. 305, 33.75; No. 1 yellow, No. 405, 23.75; manganese bronze, No. 421, 28.25.

Magnesium Alloy Ingot: AZ63A, 37.50; AZ91B, 37.25; AZ91C, 41.25; AZ92A, 37.50.

NONFERROUS PRODUCTS

BERYLLIUM COPPER

(Base prices per lb, plus mill extras, 2000 to 5000 lb; nom. 1.9% Be alloy.) Strip, $1.975, f.o.b. Temple, Pa., or Reading, Pa.; rod, bar, wire, $1.955, f.o.b. Temple, Pa.

COPPER WIRE

Bare, soft, f.o.b. eastern mills, 20,000-lb lots, 38.35; l.c.l., 38.98. Weatherproof, 20,000-lb lots, 38.55; l.c.l., 39.30.

LEAD

(Prices to jobbers, f.o.b. Buffalo, Cleveland, Pittsburgh.) Sheets, full rolls, 140 sq ft or more, $17.50 per cwt; pipe, full coils, $17.50 per cwt; traps and bends, list prices plus 30%.

TITANIUM

(Prices per lb, 10,000 lb and over, f.o.b. mill.) Sheet and strip, $6.75-15.50; sheared mill plate, $5.25-9.00; wire, $5.55-9.50; forging billets, $3.20-4.75; hot-rolled and forged bars, $3.80-6.25.

ZINC

(Prices per lb, c.l., f.o.b. mill.) Sheets, 28.00; ribbon zinc in coils, 22.50; plates, 21.50.

ZIRCONIUM

Plate, $14.00-25.00; H.R. strip, $14.00-22.90; C.R. strip, $16.00-35.00; forged or H.R. bars, $11.00-17.40.

NICKEL, MONEL, INCONEL

	"A" Nickel	Monel	Inconel
Sheets, C.R.	138	120	138
Strip, C.R.	124	108	138
Plate, H.R.	130	110	126
Rod, Shapes, H.R.	107	89	109
Seamless Tubes	157	129	200

ALUMINUM

(Selected products and sizes)

Flat Sheets: 1100, 3003, and 5005, mill finish, 30,000 lb base f.o.b. customer custody.

Thickness Range (in.)	Width (in.)	Length Range (in.)	Price Range
0.250-0.136	24-72	72-180	45.40-48.00
0.136-0.096	24-72	72-180	45.90-48.80
0.096-0.077	24-72	72-180	46.40-50.30
0.077-0.068	24-72	72-180	46.90-52.10
0.068-0.061	24-72	72-180	46.90-55.00
0.061-0.048	24-72	72-180	47.40-57.70
0.048-0.038	24-72	72-180	47.90-60.50
0.038-0.030	24-72	72-180	48.40-65.30
0.030-0.024	24-72	72-180	48.90-67.20
0.024-0.019	24-60	72-180	49.40-59.90
0.019-0.017	24-48	72-144	50.30-57.00
0.017-0.015	24-48	72-144	51.20-58.00
0.015-0.014	24-36	72-144	52.30
0.014-0.012	24-36	72-144	53.50
0.012-0.011	24-36	72-114	54.60
0.011-0.0095	24-46	72-144	56.20
0.0095-0.0085	24-36	72-96	57.50
0.0085-0.0075	24-36	72-96	59.20
0.0075-0.007	24-36	72-96	60.80
0.007-0.006	24-36	72-96	62.50

ALUMINUM (continued)

Plates and circles: Thickness, 0.25-3 in.; width or diam., 24-60 in.; lengths, 72-240 in., mill finish.

Alloy	Plate Base	Circle Base
1100, 3003-F	44.60	50.90
5050-F	45.70	50.50
3004-F	46.70	52.40
5052-F	47.30	53.10
6061-T6	47.80	53.90
2024-T4*	51.80	58.90
7075-T6*	60.50	67.90

*24-48 in. width or diam., 72-180 in. lengths.

Screw Machine Stock: 30,000 base, 12 ft lengths

Diam (in.)*	Round 2011-T3	Round 2017-T4	Hexagonal 2011-T3	Hexagonal 2017-T4
0.125	74.90	77.30	....	....
0.188	63.20	63.20	....	80.10
0.250	60.00	62.60	72.70	74.10
0.375	59.20	63.80	71.00	72.00
	2011-T3	2017-T451	2011-T3	2017-T451
0.500	59.20	63.80	71.00	72.00
0.625	59.20	63.80	67.80	67.90
0.750	57.70	62.00	61.60	63.80
0.875	57.70	62.00	61.60	63.80
1.000	57.70	62.00	61.60	63.80
1.125	55.30	59.50	59.50	61.50
1.250	55.30	59.50	59.50	61.50
1.375	55.30	59.50	59.50	61.50
1.500	55.30	59.50	59.50	61.50
1.625	53.00	56.70	....	59.30
1.750	53.00	56.70	58.30	59.30
1.875	53.00	56.70	....	59.30
2.000	53.00	56.70	58.30	59.30
2.250	51.50	55.00	....	59.30
2.500	51.50	55.00	....	59.30
2.750	49.90	53.20	....	59.30
3.000	49.00	53.20	....	59.30
3.250	....	53.20	....	....
3.375	....	53.20	....	....

*Selected sizes.

Forging Stock: Round, Class 1, random lengths, diam., 0.375-8 in., "F" temper; 2014, 47.50-57.60; 6061, 43.50-57.60; 7075, 61.80-71.90; 7079, 66.80-76.90.

Pipe: ASA schedule 40, alloy 6063-T6, 3-40 ft lengths, plain ends, 90,000 lb base, dollars per ft. Nominal pipe sizes: 1 in., 32.00; 1¼ in., 43.40; 1½ in., 51.80; 2 in., 62.60; 3 in., 124.95; 4 in., 171.80; 5 in., 233.15; 6 in., 308.55; 8 in., 464.35; 10 in., 716.25 (3-24 ft lengths).

Extruded Solid Shapes:

Factor	Alloy 6063-T5	Alloy 6062-T6
1-14	45.30-46.80	54.00-60.00
15-17	45.30-46.80	56.50-61.80
18-23	45.80-47.50	58.60-67.60
24-32	45.80-47.50	66.80-81.50
33-38	49.50-52.20	85.10-96.60
39-44	59.80-63.60	102.00-124.00

MAGNESIUM

Sheets and Plates: AZ31B standard grade, .032 in., 103.10; .081 in., 77.90; .125 in., 70.40; .188 in., 69.00; .250-2.00 in., 67.90. AZ31B spec. grades, .032 in., 171.30; .081 in., 108.80; .125 in., 98.10; .188 in., 95.70; .250-2.00 in., 93.30. Tread plate, 60-192 in. lengths, 24-72 in. widths; .125 in., 74.90; .188 in., 71.70-72.70; .25-.75 in., 70.60-71.60. Tooling plate, 0.25-3.00 in., 73.00.

Extruded Solid Shapes:

Factor	Com. Grade (AZ31C)	Spec. Grade (AZ31B)
6-8	65.30-67.60	94.60-87.40
12-14	65.30-67.60	85.70-88.00
24-26	66.10-68.40	90.60-91.30
36-38	71.50-75.30	104.20-105.30

NONFERROUS SCRAP

DEALERS' BUYING PRICES

Copper and Brass: No. 1 heavy copper and wire 22.50-23.00; No. 2 heavy copper and wire, 20.50-21.00; light copper, 18.50-19.00; No. 1 composition red brass, 17.50-18.00; No. 1 com-

BRASS MILL PRICES

MILL PRODUCTS a

	Sheet, Strip, Plate	Rod	Wire	Seamless Tubes
Copper	57.13b	54.86c	....	58.32
Yellow Brass	50.57	36.06d	50.86	54.23
Low Brass, 80%	53.53	53.22	53.82	57.09
Red Brass, 85%	54.58	54.27	54.87	58.14
Com. Bronze, 90%	56.17	55.86	56.46	59.48
Manganese Bronze	58.86	52.21	62.69	....
Muntz Metal	53.20	48.26	....	....
Naval Brass	55.12	48.68	61.43	58.78
Silicon Bronze	62.86	61.80	62.15	80.79
Nickel Silver, 10%	65.98	68.06	68.06	....
Phos. Bronze	77.44	78.19	77.69	79.37

SCRAP ALLOWANCES e (Based on copper at 33.00c)

	Clean Heavy	Rod Ends	Clean Turnings
Copper	29.000	29.000	28.250
Yellow Brass	22.250	21.250	20.250
Low Brass, 80%	24.750	24.500	24.000
Red Brass, 85%	25.750	25.500	25.000
Com. Bronze, 90%	26.750	26.500	26.000
Manganese Bronze	20.750	20.500	20.000
Muntz Metal	20.875	20.625	20.125
Naval Brass	20.750	20.500	20.000
Silicon Bronze	28.375	28.125	27.375
Nickel Silver, 10%	26.875	26.625	13.437
Phos. Bronze	29.875	29.625	28.625

a. Cents per lb, f.o.b. mill; freight allowed on 50 lb or more. b. Hot-rolled. c. Cold-drawn. d. Free cutting. e. Prices in cents per lb for less than 20,000 lb, f.o.b. shipping point. On lots over 20,000 lb at one time, of any or all kinds of scrap, add 1 cent per lb.

position turnings, 16.00-16.50; new brass clippings, 14.50; light brass, 10.50-11.50; heavy yellow brass, 11.50-12.50; new brass rod ends, 12.50-13.00; auto radiators, unsweated, 12.50-12.75; cocks and faucets, 12.75-13.25; brass pipe, 13.50-14.00.

Lead: Soft scrap lead, 8.00-8.25; battery plates, 3.00-3.25; linotype and stereotype, 9.00-9.50; electrotype, 8.00-8.25; mixed babbitt, 9.50-10.00.

Monel: Clippings, 23.00-24.00; old sheets, 22.00-23.00; turnings, 16.50-17.50; rods, 22.00-23.00.

Nickel: Sheets and clips, 50.00-51.00; rolled anodes, 50.00-51.00; turnings, 39.00-41.00; rod ends, 50.00-51.00.

Zinc: Old zinc, 3.00-3.50; new diecast scrap, 4.25-4.50; old diecast scrap, 2.75-3.00.

Aluminum: Old castings and sheets, 10.00-10.50; clean borings and turnings, 5.25-5.50; segregated low copper clips, 12.00-13.00; segregated high copper clips, 11.50-12.00; mixed low copper clips, 12.00-12.50; mixed high copper clips, 11.00-11.50.

(Cents per pound, Chicago)

Aluminum: Old castings and sheets, 10.00-10.50; clean borings and turnings, 7.00-7.50; segregated low copper clips, 15.00-15.50; segregated high copper clips, 13.50-14.00; mixed low copper clips, 12.50-13.00; mixed high copper clips, 12.00-12.50

(Cents per pound, Cleveland)

Aluminum: Old castings and sheets, 10.50-10.75; clean borings and turnings, 9.00-9.50; segregated low copper clips, 14.75-15.00; segregated high copper clips, 13.00-13.50; mixed low copper clips, 13.75-14.00; mixed high copper clips, 13.25-13.75.

REFINERS' BUYING PRICES

(Cents per pound, carlots, delivered refinery)
Beryllium Copper: Heavy scrap, 0.020-in. and heavier, not less than 1.5% Be, 59.00; light scrap, 54.00; turnings and borings, 39.00.
Copper and Brass: No. 1 heavy copper and wire, 26.00; No. 2 heavy copper and wire, 24.00; light copper, 21.75; refinery brass (60% copper) dry copper content, 22.00.

INGOTMAKERS' BUYING PRICES

Copper and Brass: No. 1 heavy copper and wire, 26.00; No. 2 heavy copper and wire, 24.00; light copper, 21.75; No. 1 composition borings, 20.25; No. 1 composition solids, 21.00; heavy yellow brass solids, 15.50; yellow brass turnings, 14.50; radiators, 16.50.

PLATING MATERIAL

(F.o.b. shipping point, freight allowed on quantities)

ANODES

Cadmium: Special or patented shapes, $1.60.
Copper: Flat-rolled, 50.04; oval, 46.50, 5000-10,000 lb, electrodeposited, 42.00, 2000-5000 lb lots; cast, 44.50, 5000-10,000 lb quantities.
Nickel: Depolarized, less than 100 lb, 114.25; 100-499 lb, 112.00; 500-4999 lb, 107.50; 5000-29,999 lb, 105.25; 30,000 lb, 103.00. Carbonized, deduct 3 cents a lb.
Tin: Bar or slab, less than 200 lb, 121.50; 200-499 lb, 120.00; 500-999 lb, 119.50; 1000 lb or more, 119.00.
Zinc: Balls, 20.50; flat tops, 20.50; flats, 23.25; ovals, 22.50, ton lots.

CHEMICALS

Cadmium Oxide: $1.60 per lb in 100-lb drums.
Chromic Acid (flake): 100-2000 lb, 31.00; 2000-10,000 lb, 30.50; 10,000-20,000 lb, 30.00; 20,000 lb or more, 29.50.
Copper Cyanide: 100-200 lb, 65.90; 300-900 lb, 63.00; 1000-19,000 lb, 61.90.
Copper Sulphate: 100-1900 lb, 16.00; 2000-5900 lb, 14.00; 6000-11,900 lb, 13.75; 12,000-22,900 lb, 13.50; 23,000 lb or more, 13.00.
Nickel Chloride: 100 lb, 45.00; 200 lb, 43.00; 300 lb, 42.00; 400-4900 lb, 40.00; 5000-9900 lb, 38.00; 10,000 lb or more, 37.00.
Nickel Sulphate: 5000-22,999 lb, 29.00; 23,000-39,900 lb, 28.50; 40,000 lb or more, 28.00.
Sodium Cyanide (Cyanobrik): 200 lb, 23.80; 400-800 lb, 20.80; 1000-4900 lb, 19.80; 5000-19,900 lb, 18.80; 20,000 lb or more, 17.60.
Sodium Stannate: Less than 100 lb, 80.10; 100-600 lb, 70.70; 700-1900 lb, 68.00; 2000-9900 lb, 66.10; 10,000 lb or more, 64.80.
Stannous Chloride (Anhydrous): 25 lb, 155.60; 100 lb, 150.70; 400 lb, 148.30; 800-19,900 lb, 107.40; 20,000 lb or more, 101.30.
Stannous Sulphate: Less than 50 lb, 140.70; 50 lb, 110.70; 100-1900 lb, 108.70; 2000 lb or more, 106.70.
Zinc Cyanide: 100-200 lb, 59.00; 300-900 lb, 57.00.

slope. Prospects for an improvement hinge on what happens to the general economy.

"Shipments this year to consuming industries will total close to the record 2,480,000 tons logged in 1959.

"Long term prospects for aluminum growth are being temporarily obscured by a present oversupply of metal in relation to current consumption and by price cutting that has seriously affected earnings of U. S. aluminum producers. The future of the aluminum industry over the long pull has never looked better."

• **Zinc**—Howard I. Young, president, American Zinc, Lead & Smelting Co., says: "Shipments of all grades of slab zinc from domestic smelter to domestic consumer during the fourth quarter will be about 215,000 tons. Add to that the overquota slab zinc (15,000 tons) which will be shipped from domestic smelters into foreign markets, and you have a total of 230,000 tons. This is assuming steel operations during the quarter average 60 to 70 per cent and that automotive production is on a basis comparable to October's.

"Zinc production during the quarter, because of labor troubles, will be about 190,000 tons. This indicates that the stocks in the hands of producers will be reduced 40,000 to 50,000 tons, leaving the total stocks at the end of December at about the same level that prevailed on Dec. 31, 1959.

"Under present domestic and foreign conditions and assuming labor disputes are not settled before Nov. 1, there should be no change this year in the prevailing base price of prime Western metal and the premiums on special high grade and other grades. I do not anticipate any upward movement in the price of zinc until total stocks of metal in the hands of domestic smelters are below 100,000 tons for all grades."

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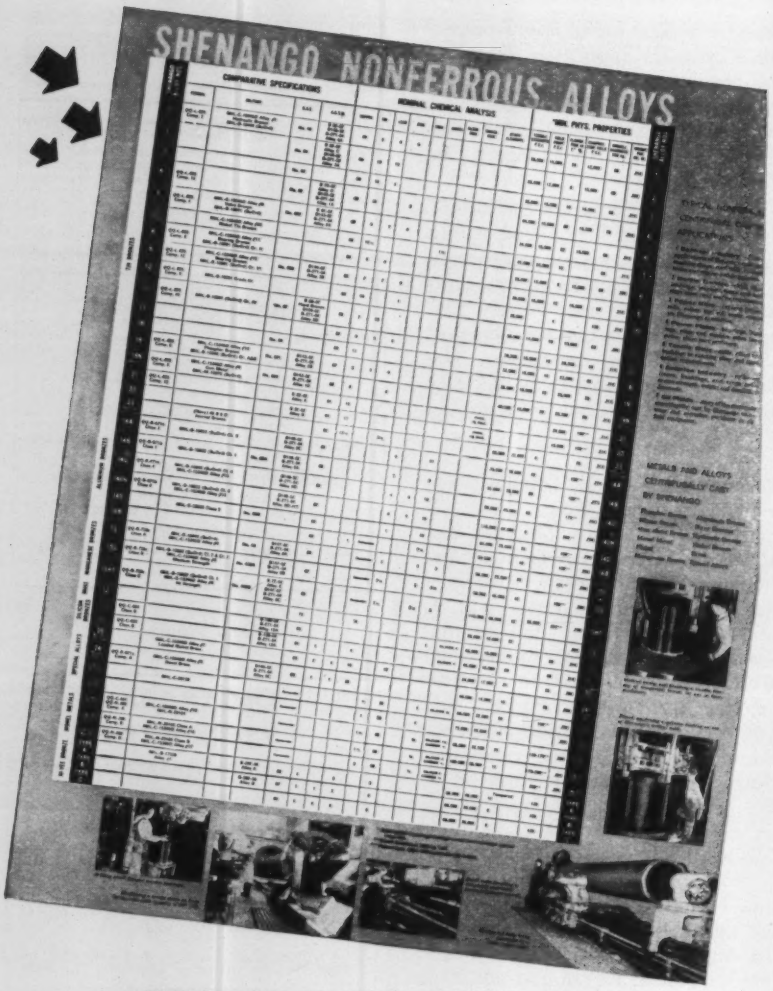

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NAME	COMPOSITION PERCENTAGE Ag	Cu	Zn	Other	MELTING POINT °F	°C	FLOW POINT °F	°C	TROY OUNCES PER CU. IN.
EASY-FLO	50	15½	16½	(18 Cd)	1160	625	1175	635	5.0
EASY-FLO 3	50	15½	15½	(16 Cd-3 Ni)	1170	630	1270	690	5.0
EASY-FLO 45	45	15	16	(24 Cd)	1125	605	1145	620	4.9
EASY-FLO 35	35	26	21	(18 Cd)	1125	605	1295	700	4.9
SIL-FOS	15	80		(5 P)	1185	640	1300	705	4.5
SIL-FOS 5	5	88¾		(6¼ P)	1185	640	1300	705	4.4
TEC*	5			(95 Cd)	640	340	740	395	4.6
TEC-Z*	5		16.6	(78.4 Cd)	480	250	600	315	4.5
BRAZE 071 (SN #7)†	7	85		(8 Sn)	1225	665	1805	985	4.8
" TL	9	53	38		1410	765	1565	850	4.5
" ATT	20	45	30	(5 Cd)	1140	615	1500	815	4.6
" 202 (AT SPEC)†	20	45	35		1315	715	1500	815	4.7
" NE	25	52½	22½		1250	675	1575	855	4.7
" 251 (AE)†	25	57½	17½		1270	690	1625	885	4.7
" NT	30	38	32		1250	675	1410	765	4.7
" DT	40	36	24		1235	670	1415	770	4.8
" SS	40	30	28	(2 Ni)	1220	660	1435	780	4.8
" 404 (SS-5)†	40	30	25	(5 Ni)	1220	660	1580	860	4.7
" DE	45	30	25		1225	665	1370	745	4.8
" ETX	50	34	16		1250	675	1425	775	5.0
" 541 (4772)†	54	40	5	(1 Ni)	1340	725	1575	855	5.1
" 560 (ER)†	56	22	17	(5 Sn)	1145	620	1205	650	5.0
" 580 (EB)†	57½	32½		(7 Sn-3 Mn)	1120	605	1345	730	5.1
" RT	60	25	15		1245	675	1325	720	5.0
" 603 (RT-SN)†	60	30		(10 Sn)	1115	600	1325	720	5.2
" 630 (RSNI)†	63	28½		(6 Sn-2½ Ni)	1275	690	1475	800	5.1
" EASY	65	20	15		1240	670	1325	720	5.1
" 655 (RE-MN)†	65	28		(5 Mn-2 Ni)	1385	750	1560	850	5.2
" MEDIUM	70	20	10		1275	690	1360	740	5.1
" BT	72	28			1435	780	1435	780	5.2
" HARD	75	22	3		1365	740	1450	790	5.3
" 752 (TR #1)†	75		25		1300	705	1330	720	5.1
" IT	80	16	4		1340	725	1490	810	5.3
" 852 (85 Ag-15 Mn)†	85			(15 Mn)	1760	960	1780	970	5.1
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